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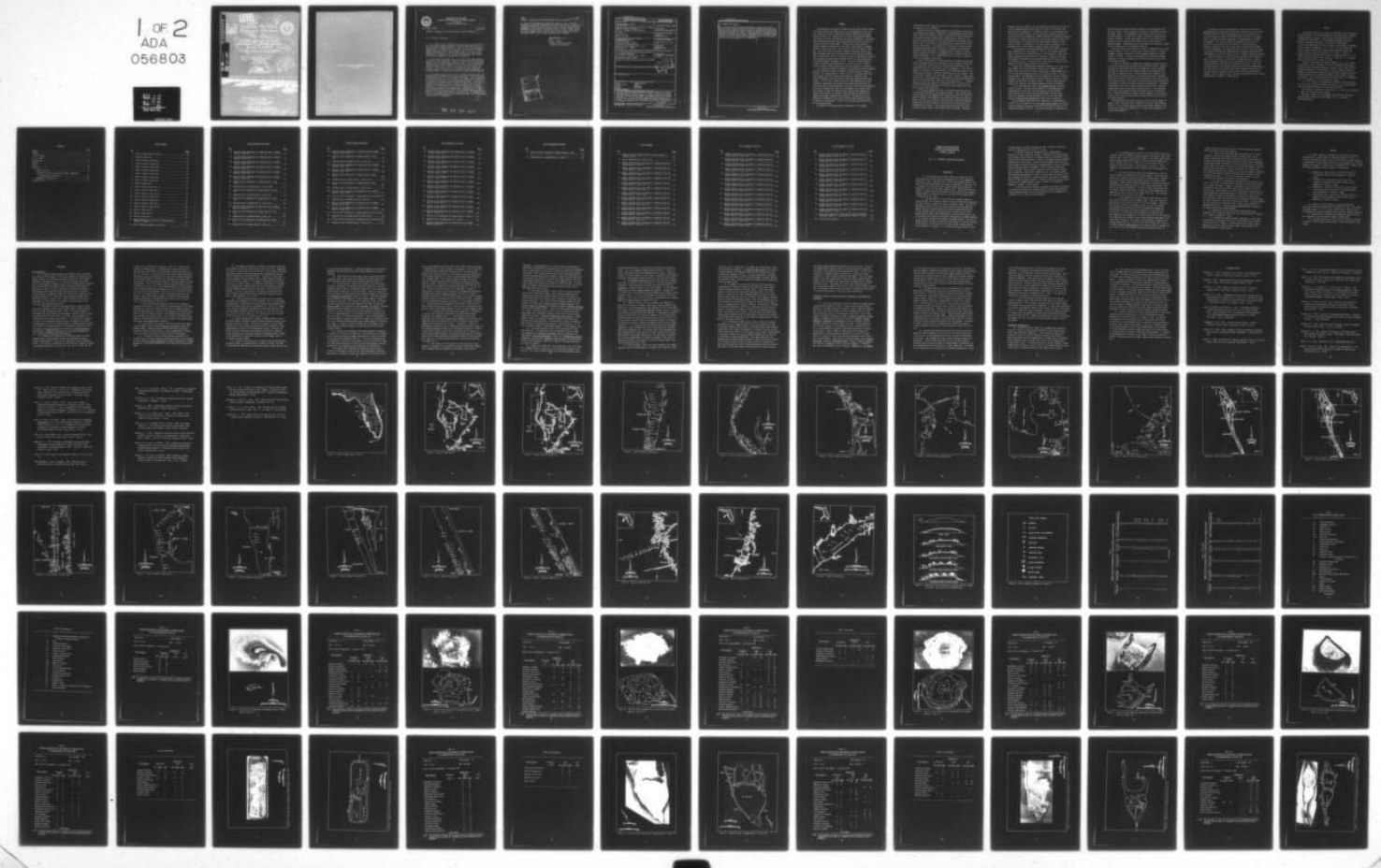

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COLONIAL BIRD USE AND PLANT SUCCESSION ON DREDGED MATERIAL ISLANDS IN FLORIDA. Volume II

VOL. II: PATTERNS OF PLANT SUCCESSION,

by
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15 June 1978

SUBJECT: Transmittal of Technical Report D-78-14 (Volume II)

TO: All Report Recipients

1. The technical report transmitted herewith represents the results of Work Unit 4F01C regarding vegetation succession and wildlife use of dredged material islands in Florida. This work unit was conducted as part of Task 4F (Island Habitat Development) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 4F was part of the Habitat Development Project of the DMRP and had as its objective the investigation, evaluation, and testing of methodologies for habitat creation and management on dredged material islands.

2. Island habitat development has been studied by the DMRP throughout the United States through the evaluation of vegetation succession and animal use of existing dredged material islands. The most significant wildlife aspect of these islands is their use by colonial nesting sea and wading birds such as gulls, terns, egrets, herons, ibises, and pelicans. This wildlife resource, although generally inadvertently created, presents a significant opportunity for habitat management and development that is consonant with continued dredged material disposal.

3. In the study reported herein (in two volumes), Work Unit 4F01C, 40 dredged material islands in Florida were selected for detailed analysis from the more than 250 in five specific study areas. These study areas were located in the vicinity of Tampa Bay, the Indian River, Yankeetown, the Pithlachascotee River, and the Caloosahatchee River. Vegetative colonization of dredged material islands proceeded from a bare substrate through a grass-herb stage characterized by species such as smooth cordgrass to a shrub and tree cover represented by Brazilian pepper, Australian pine, sabal palm, and mangroves. Approximately 50 percent of the colonial nesting sea and wading birds in Florida nest on dredged material, and many more species use the islands for feeding and roosting. Species of particular significance, because of their low numbers nationally, are the reddish egret, roseate spoonbill, least tern, black skimmer, and brown pelican (endangered).

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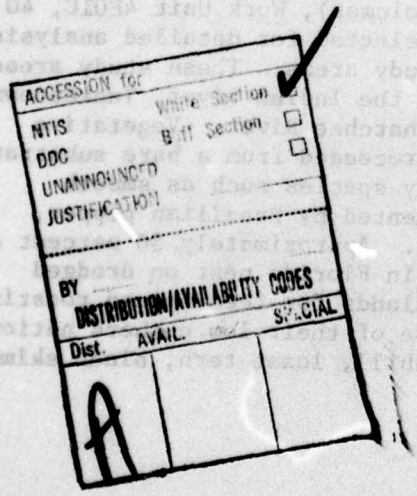
SUBJECT: Transmittal of Technical Report D-78-14 (Volume II)

4. From a local perspective, this study will be of direct value in managing and developing dredged material island habitats in Florida. A national perspective is presented in a report entitled "Development and Management of Avian Habitat on Dredged Material Islands" (4F03), which synthesizes island habitat research in Florida, the Great Lakes (4F01A), New Jersey (4F01D), North Carolina (4F02), Texas (4F01B), the Pacific Northwest (4F01E), and the Upper Mississippi River (4F01F).

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director



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This study was made to determine succession of vegetation on various aged dredged material islands in Florida. Forty islands in five selected study areas were intensively examined. An extensive literature review was conducted. Vertical aerial photographs and vegetation maps of each island are presented. A total of 141 plant species were found to occur on the islands. In Florida, typical island vegetation occurred through colonization by propagules from water-, wind-, and bird-carried sources. Marsh grasses (Continued)

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such as smooth cordgrass preceded establishment by upland species such as Brazilian pepper, Australian pine, sabal palm, and herbaceous and grass cover. Bird use of the islands was directly related to the stage of plant succession, and bird fecal material was found to affect the vegetation both adversely and beneficially depending upon location. Recommendations for management include creation of new islands and enlargement and stabilization of existing eroding islands for bird use. Maintenance of unvegetated sites as critical habitat for terns and black skimmers is also recommended.

SUMMARY

The importance of nearshore islands as nesting sites for many species of colonial seabirds and wading birds is well documented and their use has increased as natural islands and intertidal communities have been altered for man's use. Natural barrier islands and protected mangrove keys found in Florida were numerous and largely uninhabited in times past, and an abundance of wildlife has been associated with them and noted by naturalists since the late 1800s. Along with the natural habitats, colonial seabirds and wading birds are known to have nested on dredged material islands since their first creation in the early 1930s in Tampa Bay. The loss of 44% of the coastal wetlands bordering Tampa Bay and 20% of the open-water area of Biscayne Bay has occurred since the 1800s. Many of the barrier islands are now heavily used for residential buildings and the general trend has been a marked reduction in the available natural nesting habitat throughout Florida. The role of dredged material islands in providing nesting habitat for colonial species is closely tied to the plant species present and the future patterns of succession.

This study was designed to document these patterns of plant succession and their relation to avian utilization of dredged material islands in Florida. All dredged material islands in the five selected study areas were located, and forty islands were selected for intensive study. Aerial photographs were taken of each island and vegetation maps drawn of each. In the field, a general survey of plant communities was made, compared to photographs, and transects were established beginning at the island apex(s) and terminating at the edge of the shoreline vegetation. Two to four transects were used, and 1123 quadrats were sampled along the transects at specific intervals within various plant communities found on the islands. All plants in each quadrat were identified to species and voucher specimens were collected. The percent cover and height were estimated for each species and the rooted stems or trunks of shrubs or trees counted. A total of 141 species were found to occur on the islands studied.

In addition to phytosociological information, a soil sample,

representative of the upper 15 cm of soil in the quadrat, was collected at each point of all transects.

With the creation of dredged material islands primary succession of plant communities proceeds. Depending on the physiography of the island, biotic diversity of dispersal centers, and distance of the islands from the dispersal centers, various plant communities may establish. This process includes conditions which allow formation of a protected area on the lee side of an island or island placement in a location with little fetch or boat traffic. This protection is necessary in order to allow waterborne propagules time to establish root systems on the unstable, and often eroding shorelines, of dredged material islands. All three mangrove species in Florida have waterborne and strong wave action prevents establishment. This is widespread and can be seen on a number of islands in the general study area.

If the initial deposit of dredged material is elongate with one end facing the prevailing winds or boat wakes, erosion produces single spits. If the long side of the island is facing the winds, both ends of the island erode and the islands usually quickly disappears. If the initial deposit is round and in a protected area, then it may have a more or less uniform distribution of intertidal vegetation around its perimeter. This is an unusual condition, but does appear to have occurred. A more common condition is a round deposit that is eroding on one side and producing two spits on the lee side due to accretion of the same material. In extreme cases of erosion and accretion the island may appear to migrate due to continual erosion and accretion, and eventually the spits may curl and fuse to form a land-locked cove.

In Florida the pioneering species on protected shorelines may vary with latitude and distance from propagule sources. Under optimum conditions in south Florida, mangroves will pioneer on the shore if seeds are readily available. Red mangroves have historically been considered the pioneer species, but it has been noted that black mangroves and white mangroves are the true pioneers in disturbed natural areas and on new dredged material deposits. Along the central coasts of Florida, the intertidal pioneer plant is most commonly smooth cordgrass. Mangroves

gradually invade and replace the shade-intolerant cordgrass, which persists on older dredged material islands only as a fringe in the front of the outer band of red mangroves. In northern Florida, very few mangroves can survive the periodic freezes, and the pioneering cordgrass may persist or be replaced by black needlerush at higher elevations as sediments accumulate. Comparisons of islands 20 and 46 years old show that smooth cordgrass and black mangroves have approximately the same relative frequency on the younger islands. In contrast, on the older islands, mangroves are very abundant with no smooth cordgrass present except on the fringes.

If the appropriate physical conditions are not available, intertidal plant communities will not establish. This is a very common condition where a combination of high wave energy and low elevation of the initial deposit may prevent the formation of a lee side. Islands of this type are completely surrounded by a bare sandy beach and are usually experiencing heavy erosion. Certain specific islands were found that did not appear to fit this general pattern of succession.

Young islands show herbaceous communities dominant with finger grass, dune sandspur, and seaside paspalum being the most abundant species. Several have young Australian pines. Camphorweed, a common member of the 5- to 10-year herb community, appears first during the third or fourth growing season. The herbaceous and shrub communities are well mixed with groundsel-tree being the dominant shrub and dropseed, natal grass, camphorweed, and dog fennel the dominant herbs. The early stage dominants finger grass, sandspur, and seaside paspalum are much less abundant.

On 10- to 20-year-old islands, the Baccharis-Schinus- herb seral stage is present. The major plant community is shrub dominated by groundsel-tree, marsh elder, Brazilian pepper, and shrub verbena. Larger shrubs (3 to 5 m), such as Brazilian pepper and sabal palms, also occur together with some herbaceous cover in open areas which typify the Schinus-Sabal-Casuarina (20-year) stage of succession.

The most common climax (40+ years) community for dredged material islands in Florida appears to be the Casuarina-Sabal-Schinus seral stage, a forest community with dominant Australian pine that may reach 30 m in height and averages 15 to 20 m. The sabal palm appears to compete well

with both Australian pine and Brazilian pepper, tolerates shading, and eventually forms a distinct community by growing up and through the Brazilian pepper canopy. The predominance of the exotic Australian pine and Brazilian pepper in the later seral stages is unique to dredged material islands in Florida. The maritime forest climax is rare and occurs only where other factors have prevented invasion of Australian pine and Brazilian pepper. The maritime forest climax may be more common on dredged material islands north of the general study area.

Birds may influence the invasion of plants to dredged material islands through transport of seeds. This may occur through internal or external transport, and may be important in plant propagule dispersal to natural islands in Florida. The very rapid succession of the Brazilian pepper community in Florida is probably due to passerine species eating fruits and transferring them.

A five-fold difference in ammonium and phosphate concentrations due to feces from nesting birds has been noted on Florida islands. Samples of interstitial water beneath the birds confirmed that levels of ammonium more than ten times higher than ambient extended to the mangrove roots resulting in increased growth. These differences were reported to disappear when the birds were absent. Qualitative observations show that the rapid and luxuriant growth of Brazilian pepper on very rocky soil and natal grass on similar soil appears to be due to avian fecal contributions of nutrients on islands with large colonial bird populations. An example of the destructive role of feces on vegetation can be seen in mangrove communities on some islands used as nesting habitats. Young seedlings are killed by fecal deposition when the canopy is heavily occupied by birds. The open understory of these mangrove communities may contribute to use of this zone by smaller herons and egrets which can easily enter and leave mangroves.

Actual destruction of mature plants can result from the removal of twigs or small limbs from trees and shrubs to be used as nest building material. This can modify the structure of the canopy, temporarily destroy certain ground cover communities, or reverse plant succession in a heavily used community.

The creation of any new dredged material island or the addition of dredged material to an existing island offers opportunities for bird use. The need for habitat should be determined prior to island creation. It may be advisable to maintain the dredged material deposit in an unvegetated state through periodic redeposits of dredged material or removal of vegetation. This would provide badly needed nesting habitat for royal terns, least terns, and black skimmers. Herons and egrets, pelicans, spoonbills, and ibises would require the rapid establishment of 2- to 3-m mangroves. The general pattern of bird use of islands shows a decrease in use once the island passes the herb-shrub stage and with a few exceptions no return to heavy use unless a mangrove community develops.

Erosion problems are seriously threatening many of the islands presently used for nesting. The addition of dredged material to islands could prolong their usefulness as nesting habitat and also provide the bare sand habitat favored by other ground nesting species. Each time a dredging project is anticipated, beneficial uses of the dredged material such as adding to an existing nesting island or depositing directly on an older island to create an earlier successional stage should be considered. Efforts should be made to maintain and protect existing or newly created nesting, feeding, or loafing areas.

PREFACE

The work described in this report was performed as part of Contract DACW 39-76-C-0161, Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in Florida. This contract was administered by the Environmental Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. The study was undertaken as part of the Dredged Material Research Program, Island Habitat Development Project, which is managed by Dr. H. K. Smith. Contract Manager was Mary C. Landin, without whose continued assistance and patience the project would not have been successful. Dr. Robert F. Soots, Jr., Campbell College, North Carolina, served as a technical adviser. Technical review was provided by Ms. Landin, Dr. Soots, Drs. R. T. Huffman and Gary Tucker, and Ms. L. Jean Hunt, WES.

Principal investigator for Seabird Research, Inc., was Dr. Ralph W. Schrieber. James E. Poppleton of Florida Technological University, Orlando, Florida, provided immeasurable assistance in the field sampling program and botanical identifications. Frank M. Dunstan and James A. Rodgers, of the National Audubon Society, provided assistance and advice concerning sampling in the National Audubon Society Sanctuary Islands in Tampa Bay. Aerial photography was carried out by Ron C. Reichenbaugh and D. M. Michaelis of A.C.E. Photography of Tampa.

Dr. L. M. Ehrhart of the Department of Biology, Florida Technological Unviersity, provided invaluable assistance in our initial orientation to the Mosquito Lagoon and Indian River ecosystems.

The botanical field work was conducted by R. R. Lewis III and Carolyn S. Lewis, and they prepared this report.

COL John L. Cannon, CE, was Commander and Director of the Waterways Experiment Station during the study. Mr. F. R. Brown was Technical Director.

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COLONIAL BIRD USE AND PLANT SUCCESSION ON DREDGED MATERIAL ISLANDS IN FLORIDA

VOL. II: PATTERNS OF VEGETATION SUCCESSION

Introduction

1. The importance of nearshore islands as nesting sites for many species of colonial seabirds and wading birds is well documented (Pettingill, 1970). Natural barrier islands and protected mangrove keys found in Florida were numerous and largely uninhabited in times past, and an abundance of wildlife has been associated with them and noted by naturalists since the late 1800's (Howell, 1932). Along with the natural habitats, colonial seabirds and wading birds are known to have nested on dredged material islands since their first creation in the early 1930's in Tampa Bay (Mills, 1934).

2. The importance of these artificially created islands for nesting habitat has increased as natural islands and intertidal communities have been altered for man's use (Lewis and Dunstan, 1975a). Lewis (1977) documents the loss of 44% of the coastal wetlands bordering Tampa Bay between 1876 and 1976 and Chardon (1976) notes that approximately 20% of the open-water area of Biscayne Bay north of Bear Cut was filled between 1887 and 1974. Many of the barrier islands are now heavily used for residential buildings and the general trend has been a marked reduction in the available natural nesting habitat throughout Florida. The role of dredged material islands in providing nesting habitat for colonial seabirds and wading birds is closely tied to the plant species present and the future patterns of succession. This study was designed to begin to look

at these patterns of plant succession and their relation to avian utilization of dredged material islands in Florida.

3. With the creation of dredged material islands primary succession of plant communities proceeds. Depending on the physiography of the island, biotic diversity of dispersal centers, and distance of the island from the dispersal centers, various plant communities may establish (Whitehead and Jones, 1969). Carlson (1972) and Beaman (1973) have conducted studies of plant succession on dredged material islands in Sarasota Bay and Charlotte Harbor in Southwest Florida, and Dunstan and Lewis (1974) and Coastal Zone Resources Corporation (1977) have done similar work in Tampa Bay. Barnes (1971), McMurry (1971), and Simersky (1970) have examined dredged material islands in Texas; Soots and Parnell (1975) have documented succession of vegetation and bird utilization of dredged material islands in North Carolina. A complete literature review of avian utilization of dredged material islands in Florida is contained in Appendix A, Volume I, of this report.

4. This phase of the study was undertaken to document the patterns of succession of vegetation on dredged material islands in Florida and relate physiography and rates of succession to the plant communities to usefulness of the islands as nesting habitat.

Methods

5. All dredged material islands in the five selected study areas (Figures 1-20) were located, assigned a number, and an aerial color slide taken of each. The final selection of which of the islands should receive further study was made jointly by the contractor, Contract Manager Ms. Mary C. Landin, and Dr. R. F. Soots, Jr., for study areas I and II. The contractor chose the islands in study areas III, IV, and V. Table 1 summarizes the information on the 40 islands chosen for vegetative analysis.

6. A vertical black and white aerial photograph, or series on larger islands, was taken of each of the 40 islands. In the field the apex of the island was located and marked on the photograph. A general survey of the plant communites was made and these also noted on the photograph. Transects were established beginning at the apex and running through the plant communties present on the island, terminating at the edge of the shoreline vegetation. On those islands with multiple apices or no apex, transects were chosen to sample all plant communities and generally ran from one side of the island to the other. This technique provided two to four transects per island.

7. Plant communities along the transects were sampled at specified intervals depending on the community type. Herbaceous commnities were sampled at 3-m intervals with a 0.5- by 0.5-m quadrat. Shrub communities were sampled at 5-m intervals with a 2.0- by 2.0-m quadrat. Shrub communities were defined as those with dominant phanerophytes branched near the base of the stem (=caespitose) and of normal size (less than 2 m) as defined by Mueller-Dombois and Ellenberg (1974). Tree communities were sampled at 10-m intervals with 4.0- by 4.0-m quadrats. Tree communities were defined as those having dominant phanerophytes with single stems and more or less numerous lateral branches (=scapose) and a height greater than 2 m. Tall (2 to 5 m) shrub species such as Brazilian pepper (Schinus terebinthifolius) often become scapose at heights over 2 m, in which case a tree community sampling procedure was used. On

islands larger than 4.05 ha (10 acres), the distance between sampling points was doubled within each community.

8. A total of 1123 quadrats were established on 38 of the 40 vegetative study islands between February and August 1977. Due to contract requirements and a desire on the part of the investigators not to unduly disturb nesting colonial seabirds and wading birds, vegetative sampling was delayed, restricted, or for two islands, entirely prevented. In the latter case islands II-152 and II-153 had large numbers of nesting wading birds during both visits (April and August 1977) made to each. The vegetative map and plant species list for each was therefore generated from direct observation by boat from offshore of the islands to avoid disturbing the colony. It is not felt that these problems in any way compromised the validity of the data or the conclusions.

9. All plants in each quadrat were identified to species in the field, if possible, and specimens were collected for later identification or as voucher specimens, as needed. The percent cover and height were estimated for each species and the rooted stems or trunks of shrubs or trees counted. Where seedlings of trees or shrubs were present they were counted separately from mature members of that species. Within shrub or tree communities understory species were included in the sampling and data gathering. These data were entered on standardized field data sheets and later transferred to individual quadrat data sheets. Voucher specimens for all plants species identified on the islands, except protected or endangered species (e.g. sea oats, Uniola paniculata), were forwarded to the Contracting Officer's Representative.

10. References used for plant species identification were Hitchcock (1971), Lakela and Long (1970), Long and Lakela (1971), Radford et al. (1968), and Wunderlin (1974).

11. In addition to phytosociological information, a soil sample, representative of the upper 15 cm of soil in the quadrat, was collected at each point on all transects. Samples were placed in plastic bags, labeled as to transect point and island number, and forwarded to the Contracting Officer's Representative.

Results

12. Table 1 summarizes the general characteristics of the 40 dredged material islands chosen for vegetative analysis. Table 2 is a key for the vegetation maps. Tables 3-42 list the size, age, and date of photography for each island and provide a plant species list, relative frequency (frequency of a species/sum of frequencies of all species × 100), and relative abundance using the categories listed below:

a. Uncommon (U) - Not occurring in any other quadrat of all quadrats withing a given community on a specific island.

b. Infrequent (I) - occurring in 10% or less of all quadrats, but more than one quadrat, within a given community on a specific island.

c. Abundant (A) - occurring is 30% or less, but more than one quadrat and more than 10%, of all quadrats within a given community on a specific island.

d. Very Abundant (VA) - occurring in more than 30% of all quadrats, and more than one quadrat, within a given community on a specific island.

13. Figures 21 and 22 represent a postulated vegetation succession pattern for dredged material islands in Florida. These stages correspond to ages of 0, 3, 5, 10, 20, and 40+ years. Table 43 lists the dominant plant species expected at each particular stage of succession.

14. Vertical aerial photographs and vegetation maps for each of the 40 vegetation study islands are shown in Figures 23-75.

15. A complete plant species list of all 40 islands is contained in Table 44. The list notes the occurrence of 141 plant species on the islands.

Discussion

Plant succession

16. As noted by Mueller-Dombois and Ellenberg (1974), the classical division of this subject is into xerarch (upland or terrestrial) and hydrarch (aquatic or intertidal) succession, and each will be discussed separately. The emphasis will be a discussion of primary succession: that is, plant community changes with time on new dredged material deposits. Many of the islands in the general study area have received multiple deposits over a period of time. Records of the timing and location of these deposits are largely nonexistent because the actual location of private and public dredging and deposition sites was not required to be accurately located until recent years, and designated disposal sites often covered several square miles. Careful examination of old aerial photography has revealed some of the deposits, but not enough to realistically assess secondary succession.

17. Intertidal succession on dredged material islands has been previously discussed by Carlson (1972), Beaman (1973), Dunstan and Lewis (1974), and Lewis and Dunstan (1975a, 1975b). The pioneer community only establishes under appropriate physiographic conditions which include a protected area on the lee side of an island or island placement in a location with little fetch or boat traffic. This protection is necessary in order to allow waterborne propagules time to establish root systems on the unstable, and often eroding shorelines, of dredged material islands. Davis (1940) first recognized that all three mangrove species in Florida (red mangrove, Rhizophora mangle; black mangrove, Avicennia germinans; white mangrove, Laguncularia racemosa) have waterborne propagules and that "strong wave action prevents establishment."

18. Formation of a protected cove on the lee side of an island through erosion on the windward side was first mentioned by Carlson (1972) and documented for island I-58 in Tampa Bay by Lewis and Dunstan (1975a). This process is widespread and can be seen on a number of islands in the general study area (I-39, Fig. 27; I-54, Fig. 31; II-88, Fig. 54;

II-125, Fig. 61; II-128, Fig. 62; and V-1, Fig. 71). If the initial deposit of dredged material is elongate with one end facing the prevailing winds or boat wakes, erosion produces single spits (I-59, Fig. 35; I-61, Fig. 38). If the long side of the island is facing the winds, both ends of the island erode and the island usually quickly disappears. If the initial deposit is round and in a protected area, then it may have a more or less uniform distribution of intertidal vegetation around its perimeter. This is an unusual condition, but does appear to have occurred on II-26 (Fig. 45). A more common condition is a round deposit that is eroding on one side and producing two spits on the lee side due to accretion of the same material (I-39, Fig. 27; I-58, Fig. 33; II-88, Fig. 54). In extreme cases of erosion and accretion (see Lewis and Dunstan, 1975a), the island may appear to "migrate" due to continual erosion and accretion, and eventually the spits may curl and fuse to form a land-locked cove (II-125, Fig. 61).

19. Once the appropriate physical factors exist, waterborne propagules may establish. In Florida the pioneering species on protected shorelines may vary with latitude and distance from propagule sources. Under optimum conditions in south Florida, mangroves will pioneer on the shore if seeds are readily available. Red mangroves have historically been considered the pioneer species, but as Carlson (1972) noted, black mangroves and white mangroves are the true pioneers in disturbed natural areas and on new dredged material deposits.

20. Along the central coasts of Florida, the intertidal pioneer is more commonly smooth cordgrass (Spartina alterniflora) (Lewis and Dunstan, 1975b). Mangroves gradually invade and replace the shade-intolerant cordgrass, which persists on older dredged material islands only as a fringe in the front of the outer band of red mangroves.

21. In northern Florida, very few mangroves can survive the periodic freezes, and the pioneering cordgrass may persist or be replaced by black needlerush (Juncus roemerianus) at higher elevations as sediments accumulate. No published observations of this pattern of succession are known.

22. The vegetative analyses of islands is this study confirm the basic pattern as outlined for the central coasts of Florida. Comparison of Table 10 (I-54, 20 years old) with Table 11 (I-58, 46 years old) shows that smooth cordgrass and black mangroves have approximately the same relative frequency on the younger island. In contrast, on the older island, mangroves are very abundant with no smooth cordgrass present in any of the quadrats sampled. It is known to be present on the island, but only as a fringe in front of the mangrove forest where it can apparently withstand more inundation time than any of the mangrove species. The most dominant mangrove species on the older island is the black mangrove. This may is part be due to differences in elevation since this is known to greatly effect the distribution of mangrove species (Davis, 1940; Detweiler et al., 1975).

23. If the appropriate physical conditions are not available, intertidal plant communities will not establish. This is a very common condition where a combination of high wave energy and low elevation of the initial deposit may prevent the formation of a "lee" side. Islands of this type are completely surrounded by a bare sandy beach and are usually experiencing heavy erosion (I-4, Fig. 23; I-48, Fig. 28; I-60, Fig. 36; I-65, Fig. 40; II-80, Fig. 52; II-129, Fig 63; III-7, Fig 66; III-12, Fig 68; III-13, Fig. 69; and V-4, Fig. 73).

24. Upland succession for a number of dredged material sites in the United States, including Florida, has been discussed by Coastal Zone Resources Corporation (1977). The report of Dunstan and Lewis (1974) provided most of the information about upland plant succession on those dredged material islands in Hillsborough Bay, Florida. The major conclusion of Coastal Zone Resources Corporation (1977) that a maritime forest represents the climax plant community on dredged material islands in Florida was not the conclusion of Carlson (1972), Beaman (1973), nor Dunstan and Lewis (1974).

25. Figure 21 illustrates the six stages in the generalized plant succession pattern for dredged material islands in Florida. The names of the stages were derived from the dominant plants or plant type occurring

in the upland plant communities. Intertidal communities, as previously mentioned, are often absent and quite variable depending on erosion patterns.

26. Table 43 lists the major plant species associated with each succession stage. Both Figure 21 and Table 43 are derived from the overall general pattern observed and indicated from data analysis.

27. Certain specific islands do not appear to fit this general pattern of succession. The two most important exceptions are the two vegetation study islands in the Mosquito Lagoon (Fig. 12) at the northern end of specific study area II (II-12 and II-26). These two islands are at least 25 years old and neither had any Brazilian pepper nor Australian pine (Casuarina equisetifolia) (Tables 17 and 18). These two introduced species generally become dominant on older dredged material islands in the general study area. Their absence on these two islands has allowed the native maritime forest climax community consisting of sabal palm (Sabal palmetto) and southern red cedar (Juniperus silicicola) to develop. Observations during sampling just after one of the worst freezes in Florida in 100 years (January 1977) indicate Australian pines are sensitive to freeze damage and its distribution north of the Indian River may be limited by its limited cold tolerance. Similar freeze damage to Brazilian pepper was observed, though not as severe as in Australian pine. It is also possible that both species have limited propagule sources near the islands. In general, further investigation is necessary to accurately determine succession patterns in both this part of Florida and northern Florida.

28. Another minor exception to the general pattern illustrated in Figure 21 is island I-58 in Tampa Bay. No Australian pine is present on this island and Brazilian pepper represents only a minor constituent of the upland plant community (Table 11). The lack of Australian pine is probably due to the early establishment of this island (1931), before this species was widespread in Florida, and its physiography, which may prevent seeds from reaching suitable substrates for germination.

29. Beaman (1973) indicates that Australian pine has been in Florida for only about 70 years and its spread throughout Florida has been greatly assisted by plantings for windbreaks in agricultural areas

and on public beaches to provide shade. Davis (1942) reports its spread on Loggerhead Key in the Dry Tortugas from plantings. He also notes that "it seems entirely possible that these plants will continue to grow whether or not they are cared for, and eventually they may replace some of the present vegetation, for after they have become large few plants can live under them." This agressive growth form with very rapid increase in height (60 cm/yr) and elimination of smaller plant forms under its canopy is most obvious in disturbed plant communities or bare areas where it can establish and dominate other species. This may, in part, be due to its unique ability to fix atmospheric nitrogen, a characteristic found in at least 20 genera of nonleguminous angiosperms including the wax myrtle (Myrica cerifera) (Silver et al., 1966), a dominant plant species in the late-seral stages of succession on dredged material islands in North Carolina (Soots and Parnell, 1975). Australian pine also has negative geotropic curvature of its root system (Silver et al., 1966) which allows rapid uptake of intermittent rainfall moisture. Both of these characteristics adapt it well to xeric, nutrient-poor soils typical of most of the dredged material islands in Florida (Beaman, 1973).

30. In already well-established plant communities, this species may not be able to naturally establish and dominate native species (Craighead, 1971; Beaman, 1973). It is quite possible that both Australian pine and Brazilian pepper cannot compete with the native plant communities such as are present on island I-58, where a native plant community has existed for over 40 years. In contrast, island V-1 is approximately the same age, but is dominated by Australian pine (Table 40). The difference appears to be due to (1) the lower latitude of V-1 which is more ideally suited for this plant's growth and (2) V-1 appears to have had many species planted on it and may have been used as a residence. Island I-58 has been protected by the National Audubon Society since the early 1930's as a wildlife sanctuary and few if any plant species were ever planted on it.

31. Some authors feel that Australian pine seeds may survive immersion in seawater and be transported to some sites by water (Beaman, 1973), although there is apparently no experimental proof of this

hypothesis. The physiography of an island could be very important in controlling the dispersal of Australian pine if the seeds are waterborne, since a steep slope or erosion bluff could prevent seeds from reaching the uplands. This condition apparently exists on two dredged material islands in Sarasota Bay and has allowed a southern red cedar-sabal palm climax community to develop in an area with a good supply of seeds and ideal growing conditions for Australian pine (Beaman, 1973). A similar steep slope due to erosion has existed on island I-58 since its creation (Lewis and Dunstan, 1975a) and may have contributed to the lack of Australian pine on this island.

32. With these exceptions, Figure 21 does illustrate a pattern seen on most of the other islands. Very few young dredged material islands were present in the general study area, but I-65 (Table 15), II-129 (Table 32) and IV-1 (Table 39) do illustrate the very early herb stage of succession. On all three islands herbaceous communities were dominant with finger grass (Chloris glauca and Chloris petraea), dune sandspur (Cenchrus tribuloides), and seaside paspalum (Paspalum vaginatum) being the most abundant species. Several have young Australian pines and IV-1, being a year older than the rest (4 years), shows the beginning development of an intermediate community where herbs and other grasses become more dominant. Camphorweed (Heterotheca subaxillaris), a common member of the 5- to 10-year herb community, appears first during the third or fourth growing season. Soots and Parnell (1975) also reported this species' first appearance during year 3 in North Carolina. Its is also an important plant on young dredged deposits in Texas (Barnes, 1971).

33. The herb-shrub seral stage is best illustrated by island I-66 (Table 16). The herbaceous and shrub communities are well mixed with groundsel-tree (Baccharis halimifolia) being the dominant shrub and dropseed (Sporobolus domingensis), natal grass (Rhynchelytrum repens), camphorweed, and dog fennel (Eupatorium capillifolium) the dominant herbs. The early stage dominants finger grass, sandspur, and seaside paspalum are much less abundant.

34. Islands III-7 (Table 35), III-8 (Table 36), and III-12 (Table 37), although they are 12 years old, also illustrate this stage of succession. This is due to their distance from shore and propagule sources

and extreme open exposure to the open Gulf of Mexico and its periodic storms. This is an example of where extremes of physical stress can slow or stop plant succession on dredged material islands. Island I-4 (Table 3) is another example of this, where a 15-year-old island supports a dominant plant community characteristic of a very early seral stage.

35. The Baccharis-Schinus-herb seral stage (10 year) is present on islands I-39 (Table 7) and I-54 (Table 10). On I-39 the major plant community is shrub dominated by groundsel-tree and marsh elder (Iva frutescens). Brazilian pepper is also very abundant. On I-54 groundsel-tree and shrub verbena (Lantana camara) are dominant. Although I-54 is 20 years old, it has received a second dredged material deposit within the last 10 years. It is this second deposit that supports this plant community. This is one of the few examples of documentation of secondary deposits on dredged material islands in Florida.

36. Island I-59 (Table 12) has a dominant tree community of large (3 to 5 m) Brazilian pepper, sabal palms, shrubs (groundsel-tree, marsh elder, and shrub verbena) and some herbaceous cover in open areas. It is typical of the Schinus-Sabal-Casuarina (20-year) stage of succession. The Australian pine portion of the community is represented by scattered trees, but their ability to dominate a community with time means that ultimately they will increase and perhaps cover the entire island. The similar agressive growth of Brazilian pepper has pushed it up through the shrub cover typically provided by groundsel-tree and it has largely replaced it. It is interesting to note that the only Brazilian pepper observed on island I-66 (herb-shrub seral stage) were small seedlings under mature groundsel-tree. The seedlings most likely developed from seeds dropped there in fecal deposits by birds roosting in the shrubs. Some nesting by red-winged blackbirds has also been noted in groundsel-tree on other dredged material islands in the general study area and these may contribute to the transfer of Brazilian pepper seeds to the islands (Dunstan and Lewis, 1974).

37. The most common "climax" (40+ years) community for dredged material islands in Florida appears on islands II-87 (Table 24), II-88

(Table 25), and V-1 (Table 40). The reasons for the exception of I-58 have already been discussed. The Casuarina-Sabal-Schinus seral stage is a forest community with dominant Australian pine that may reach 30 m in height and averages 15 to 20 m. The sabal palm appears to compete well with both Australian pine and Brazilian pepper, tolerates shading, and eventually forms a distinct community by growing up and through the Brazilian pepper canopy.

38. In summary, the generalized upland succession pattern on dredged material islands in Florida is very similar to that in North Carolina discussed by Soots and Parnell (1975). Unlike that study, however, no data exist on very early succession (years 1 to 3), and species of pines are very rare on dredged material islands in Florida. Oaks were never observed on any of the islands in the general study area and are assumed to be completely absent. Also, the predominance of the exotic Australian pine and Brazilian pepper in the later seral stages is unique to dredged material islands in Florida. The conclusion of Coastal Zone Resources Corporation (1977) that a maritime-like forest with oaks results if succession is allowed to proceed is not supported by this study. The maritime forest climax is rare and occurs only where other factors have prevented invasion of Australian pine and Brazilian pepper. The maritime forest climax may be more common on dredged material islands north of the general study area.

39. The numbers of plant species listed in Tables 3 through 42 are generally low in comparison with similar lists generated for some of the same islands by other studies. For example Coastal Zone Resources Corporation (1977) reports the presence of 70 species of plants on I-58 (Bird Island), while Table 11 in this report lists only 32. The difference is not due to changes in the plant community between 1974 and 1977 but to differences in sampling techniques. The larger species list was developed by two separate teams of botanists working over several seasons on the island and thus reflects an intensive effort to identify all plant species occurring on the island including many of the rare species. The smaller list was the result of identification of plants occurring

only within sampled quadrats during one visit to the island. Thus the less common species might not occur in a sampled quadrat or might not be present in the winter when this sampling took place. The only valid comparison of phytosociological data would be a comparison of data collected in a similar manner during the same season. There are marked changes in the plant communities following the typical heavy rainfall months of July and August, but these seasonal changes were not recorded during this study. The general conclusions about community types and plant succession on these islands are not altered by these seasonal changes, and as noted before the more intensive botanical sampling did not result in a better understanding of the upland succession patterns.

Influence of birds on invasion of plants, vegetation, and patterns of succession

40. Birds may influence the invasion of plants to dredged material islands through transport of seeds. This may occur through internal (endozoic) or external (ectozoic) transport. Darwin (1859) was probably the first to note avian transport of plant propagules when he proved viable seeds were present in mud adhering to birds feet. Davis (1942) suggests the endozoic transport of seeds of Scaevola, Coccoloba, Solanum, Lantana, and Opuntia and the extozoic transport of Cenchrus, Cyperus, Chamaesyce, Andropogon, and Borrichia may also be important in plant propagule dispersal to natural islands in Florida. Cruden (1966) felt that "mountain hopping" (=island hopping) by birds transporting seed was a viable hypothesis to explain long-distance dispersal of disjunct island groups. Proctor (1968) and Vlaming and Proctor (1968) have demonstrated the viable passage or regurgitation of seed of 33 plant species in a variety of birds including least sandpiper, lesser yellow-legs, and mockingbird. Plant species included are pepper grass (Lepidium virginicum), goosefoot (Chenopodium album), hackberry (Celtis laevigata), four species of Eleocharis, and two species of Cyperus. In addition they report the presence of seeds of Sida sp., Cenchrus sp., and Solanum

sp. in the digestive systems of killdeer shot in the field. The fruit of Brazilian pepper is bright red and commonly eaten by many passerine species. The very rapid succession of the Brazilian pepper community on I-59 is probably due to passerine species such as towhee and red-winged blackbird eating Brazilian pepper fruits on I-58 and the adjacent shore and transferring them to I-59. Similar transfer of wax myrtle seeds has been reported by Soots and Parnell (1975) by yellow-rumped warblers and tree swallows in North Carolina.

41. Increased fertility of soils on dredged material islands in North Carolina through fecal deposits has been reported by Soots and Parnell (1975). A five-fold increase in phosphorus and major increases in nitrogen were noted between dredged material with nesting and those without nesting. Onuf et al. (1977) compared water samples collected beneath a mangrove canopy on a dredged material island in the Indian River, Florida (south of study area II), that had nesting birds with an adjacent open-water area and recorded a similar five-fold difference in ammonium and phosphate. Samples of interstitial water beneath the birds confirmed that levels of ammonium more than ten times higher than ambient extended to the mangrove roots. These differences were reported to disappear when the birds were absent. Repeated measurements on red mangrove branches at the rookery site showed greater additions of leaves, reproductive parts, new lateral branches, and stem diameter. Herbivory by insects was also greatly increased and this reduced the expected increased biomass of leaves due to the increased soil fertility by one-half.

42. Qualitative observations show that the rapid and luxuriant growth of Brazilian pepper on very rocky soil on I-59 and natal grass on similar soil on I-66 appears to be due to avian fecal contributions of nutrients. Both islands have large colonial seabird and wading bird populations. Gillham (1956) notes that not only can fecal deposits encourage growth in what are termed "ornithocoprophilous vegetation" but can cause destruction or complete loss of other communities. An example of this destructive role can be seen in the mangrove communities on I-58

and II-66 where both are used as colonial nesting habitats for egrets and herons. The dominant black mangrove and white mangrove form a community with very few trunks (0.30 per m^2) and a dense canopy. Seedlings may establish under this canopy during the major seed drop in August and September. These young plants are, however, killed by fecal deposition during January to May of each year when the canopy is heavily used for nesting. The open understory of these mangrove communities may contribute to use of this zone by smaller herons and egrets which can easily enter and leave the mangroves. Trunk densities in a mature mangrove community in Tampa Bay have been reported at 3.1 to 15.9 per m^2, depending on the species, by Detweiler et al. (1975). This particular community was not used as a colonial nesting site.

43. Actual destruction of mature plants can result from the removal of twigs or small limbs from trees and shrubs to be used as nest building material. This can modify the structure of the canopy, temporarily destroy certain ground cover communities, or reverse plant succession in a heavily used community (Gillham, 1963; Dunstan and Lewis, 1974; Wiese, 1977). The trampling of grasses (sandspur, natal grass, seaside paspalum) by laughing gulls may temporarily prevent early spring growth of these species on I-49B and I-66. However, the combination of fecal fertilization and summer rains after the end of the nesting season appears to offset this damage.

Management recommendations

44. Williams and Martin (1968) first suggested the creation of artificial islands for brown pelican rookeries in Florida and Carlson (1972) added additional suggestions. Lewis and Dunstan (1975a) have proposed a design for artificial rookery islands and this design is being incorporated into the dredged material disposal plan for the Tampa Harbor Deepening Project with two small islands of this design being created (Lewis, 1977). In addition one end of I-59 has received a recent dredged material deposit in order to add to the available habitat of that island and also to replace portions of the island lost to erosion.

45. The creation of any new dredged material island or the addition of dredged material to an existing island offers opportunities for bird usage. The type of habitat and location should be determined prior to island creation through consultation with local professional ornithologists. It may be advisable to maintain the dredged material deposit in an unvegetated state through periodic redeposits of dredged material or removal of vegetation. This would provide badly needed nesting habitat for species such as least terns and black skimmers. Proposed brown pelican or heron rookeries, on the other hand would require the rapid establishment of 2- to 3-m mangroves, which may require active planting and fertilization efforts. Although some species of birds have been observed using Australian pine for nesting (e.g. great blue heron, yellow-crowned night heron, double-crested cormorant) and large numbers of birds such as white ibis use Brazilian pepper for nesting on I-59, the general pattern of avian utilization of dredged material islands shows a decrease in usage once the island passes the herb-shrub stage (Figure 21) and with a few exceptions no return to heavy use unless a mangrove community develops.

44. Erosion problems are seriously threatening many of the islands presently used for nesting such as I-61 in Hillsborough Bay where a laughing gull colony has existed for a number of years. The addition of dredged material to the westerly end of the island could prolong its usefulness as nesting habitat and also provide the bare sand habitat favored by other ground nesting species. Each time a dredging project is anticipated beneficial uses of the dredged material such as adding to an existing nesting island or depositing directly on an older island to create an earlier successional stage should be considered. In addition the recommendations in Volume I of this report should be instituted to maintain and protect existing or newly created nesting, feeding, or loafing areas.

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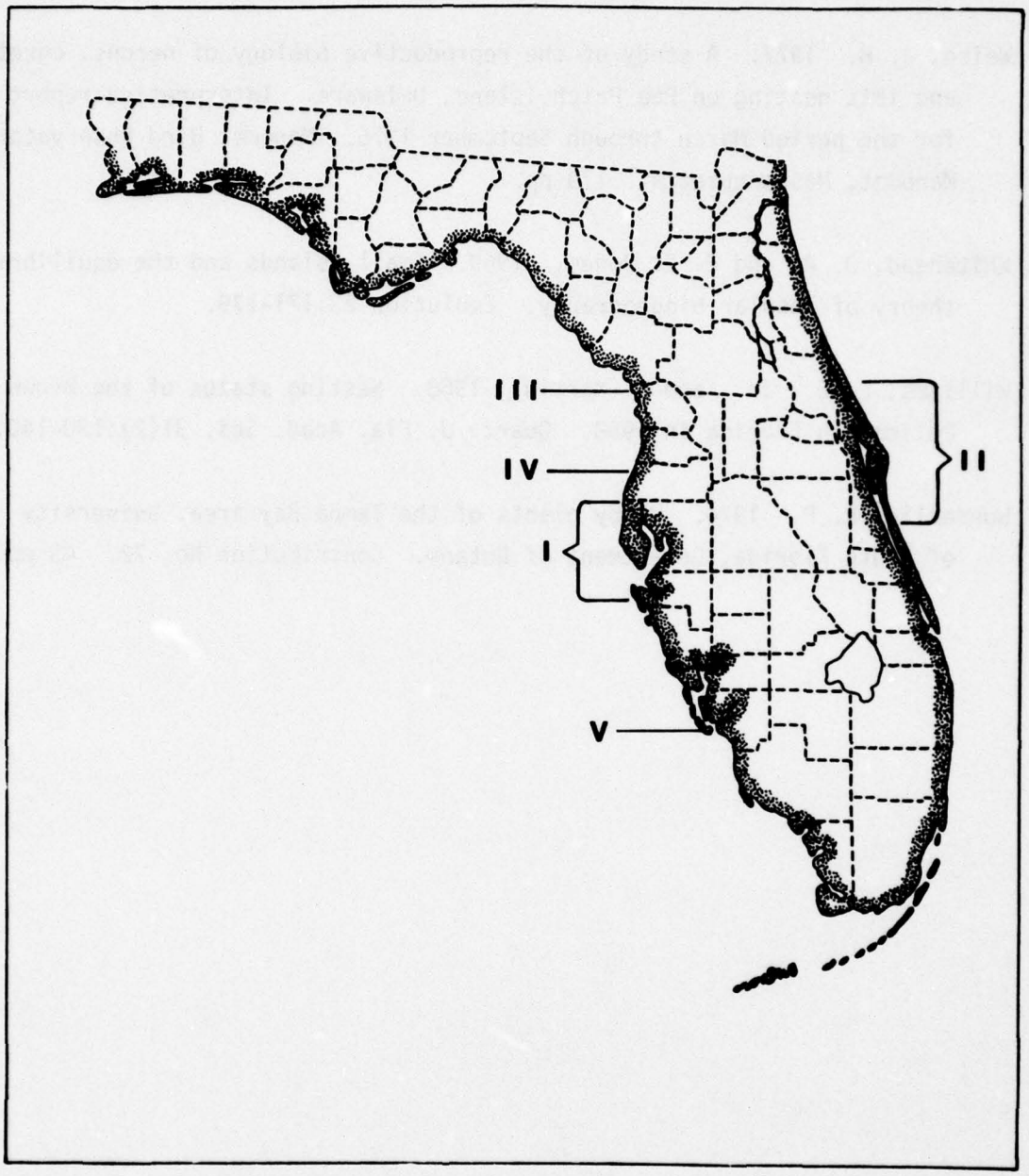


Figure 1. Specific study areas in Florida.

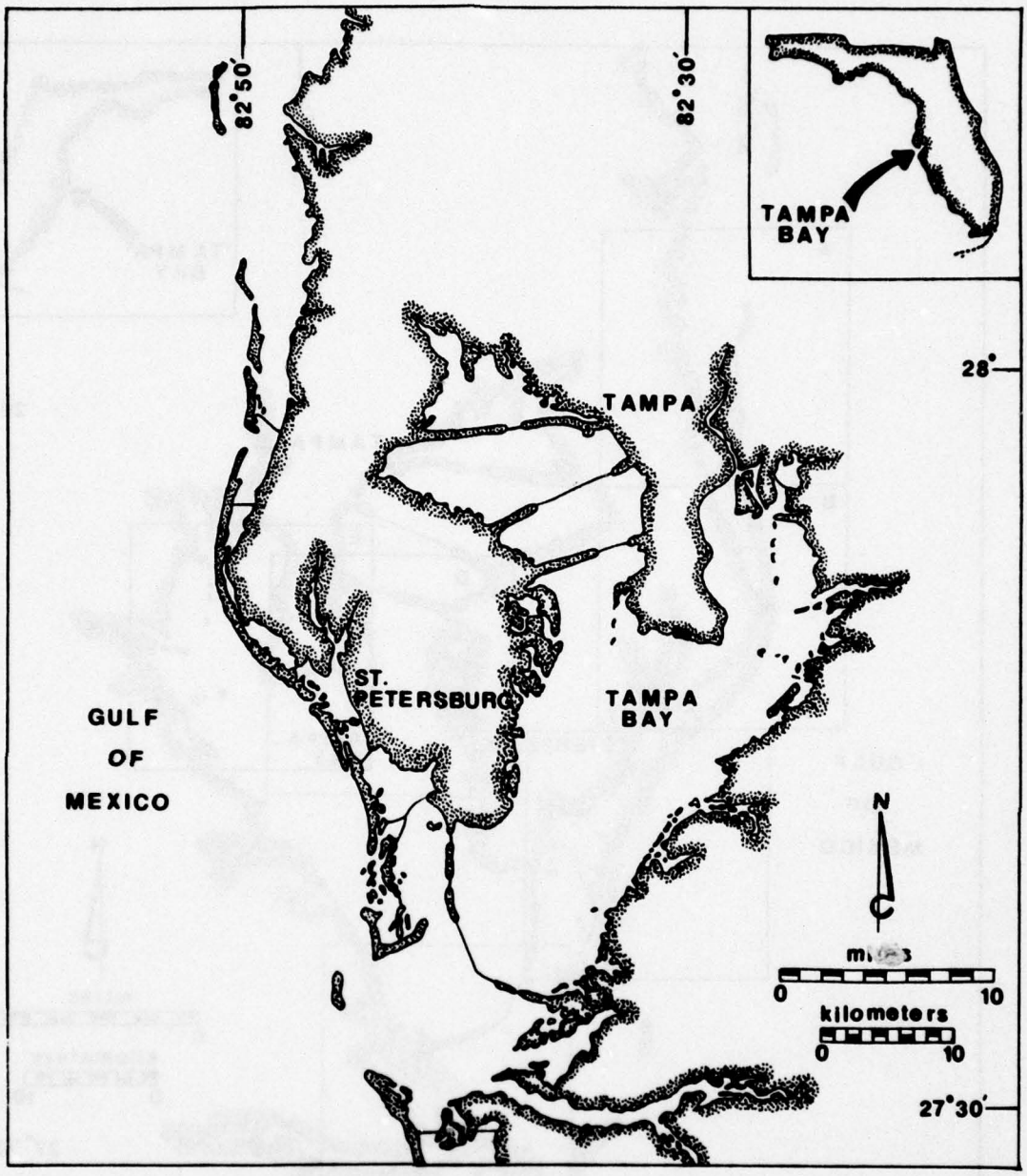


Figure 2. Specific study area I.

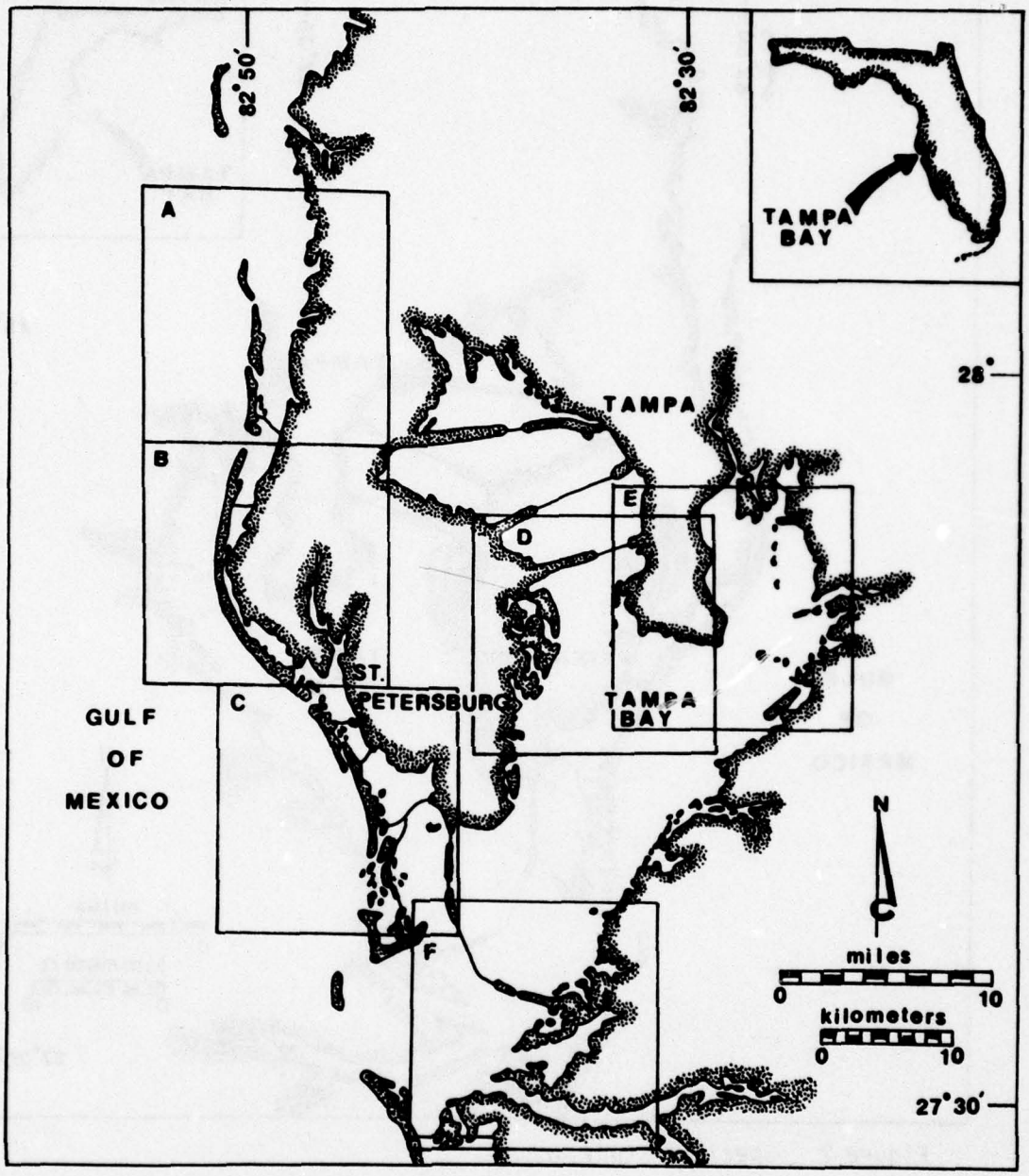
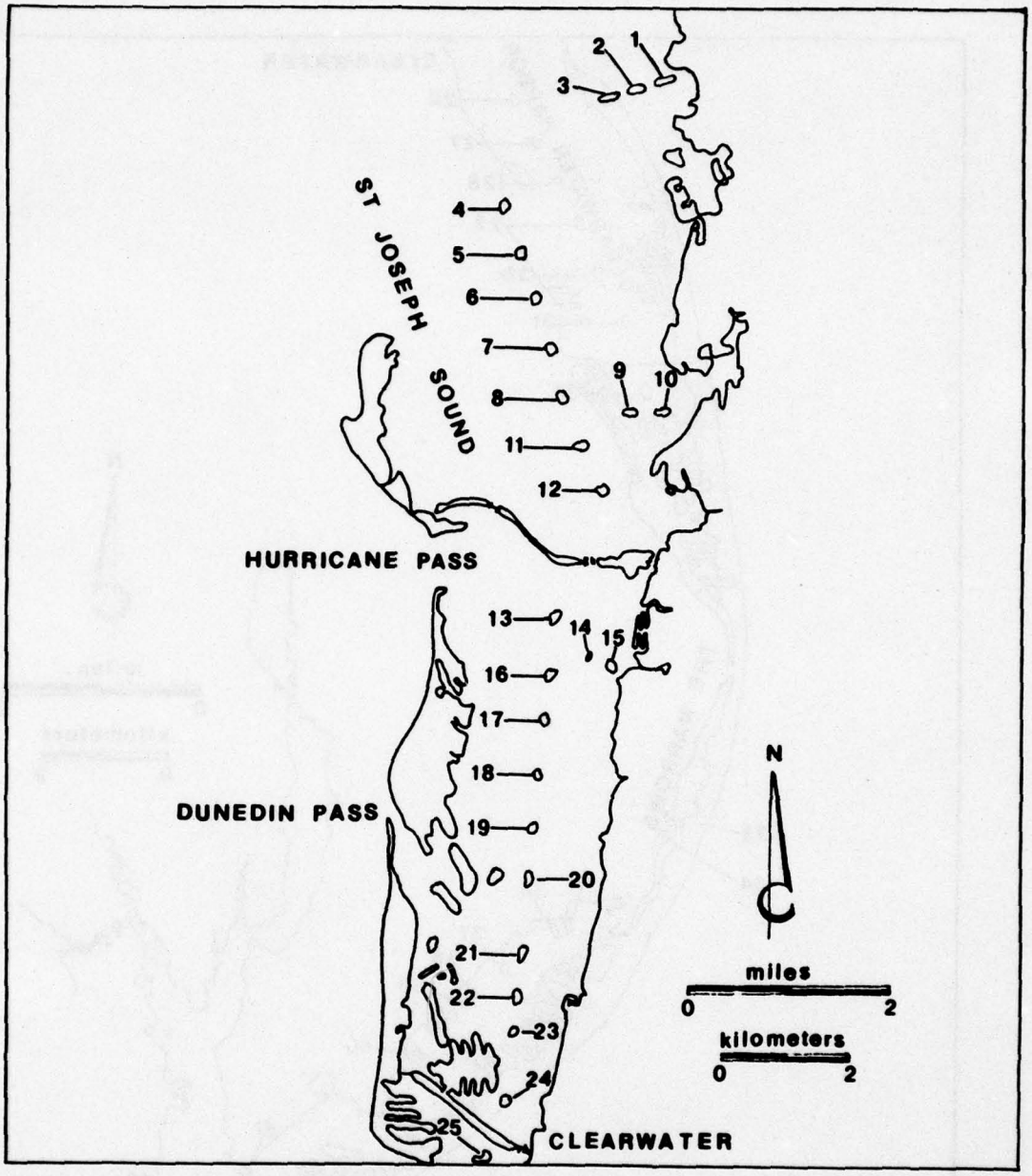


Figure 3. Insets, specific study area I.



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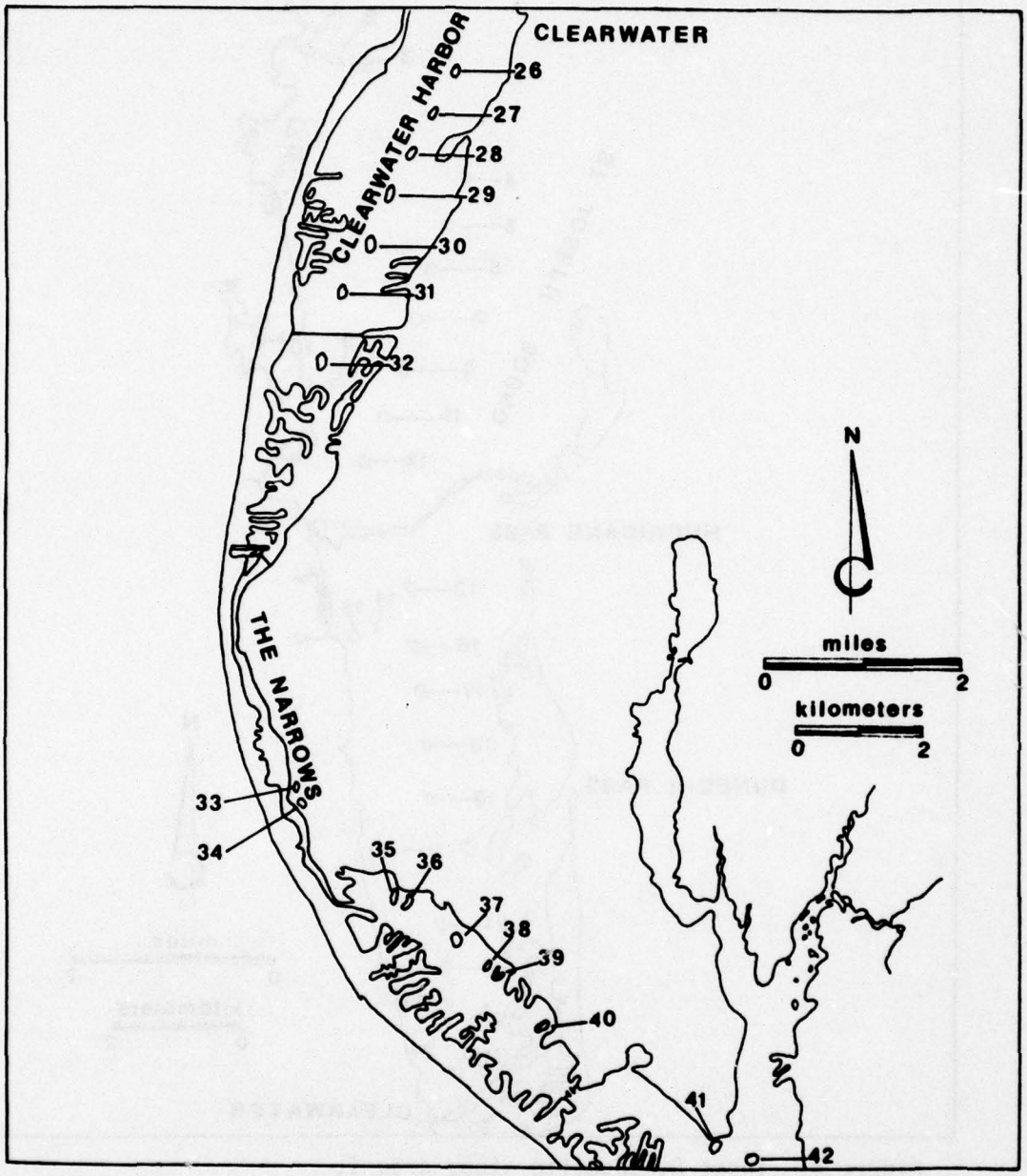

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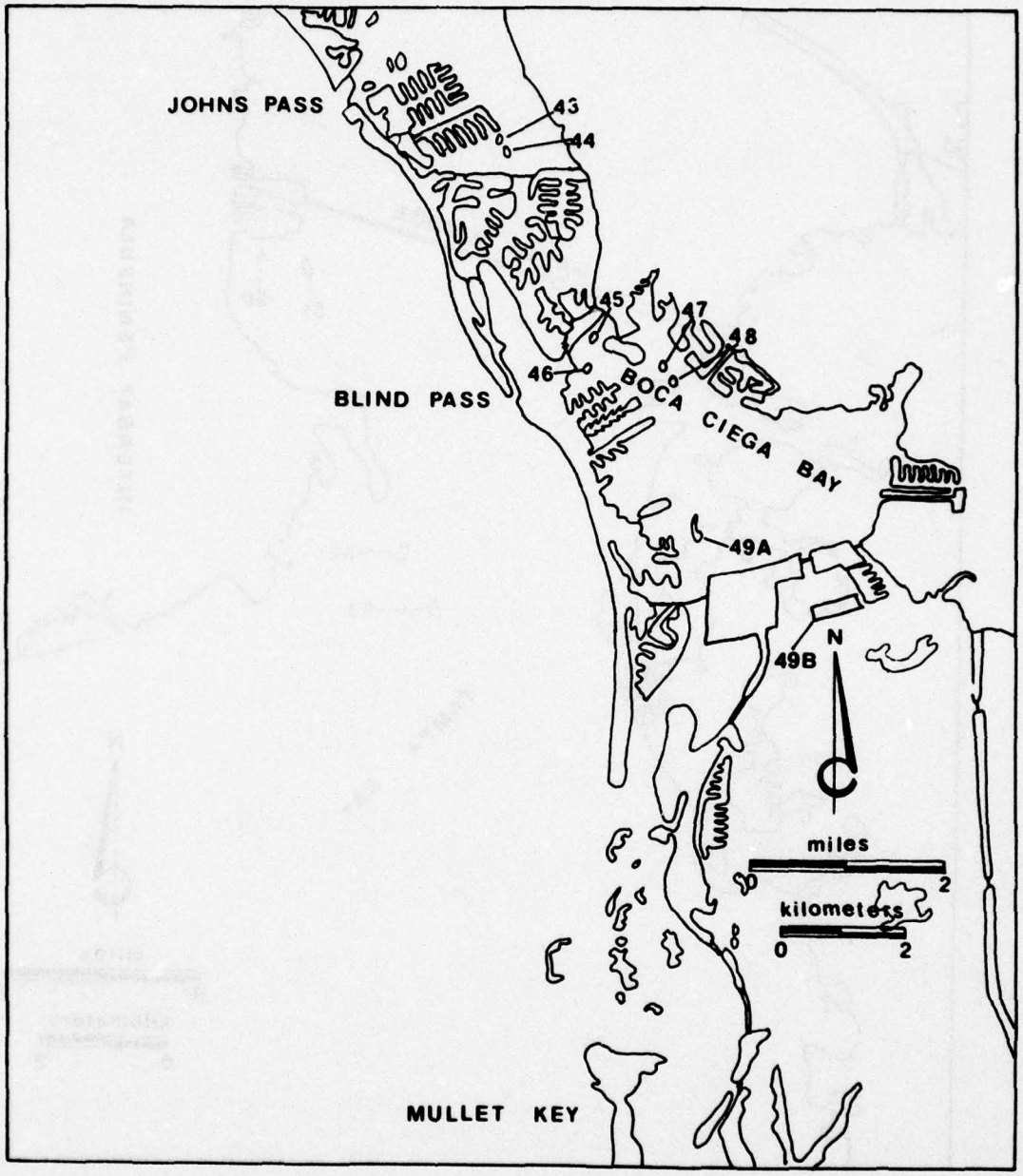

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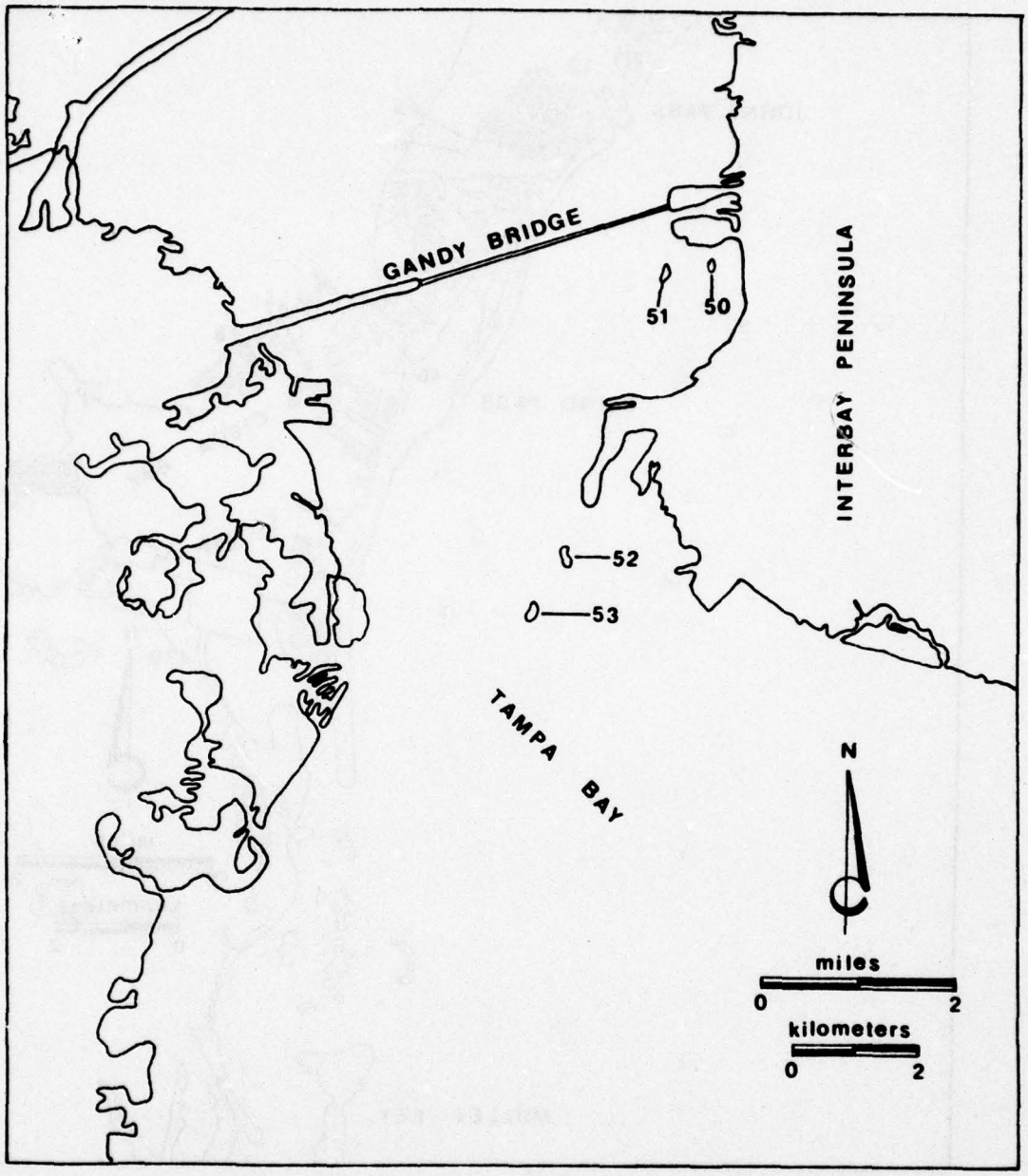

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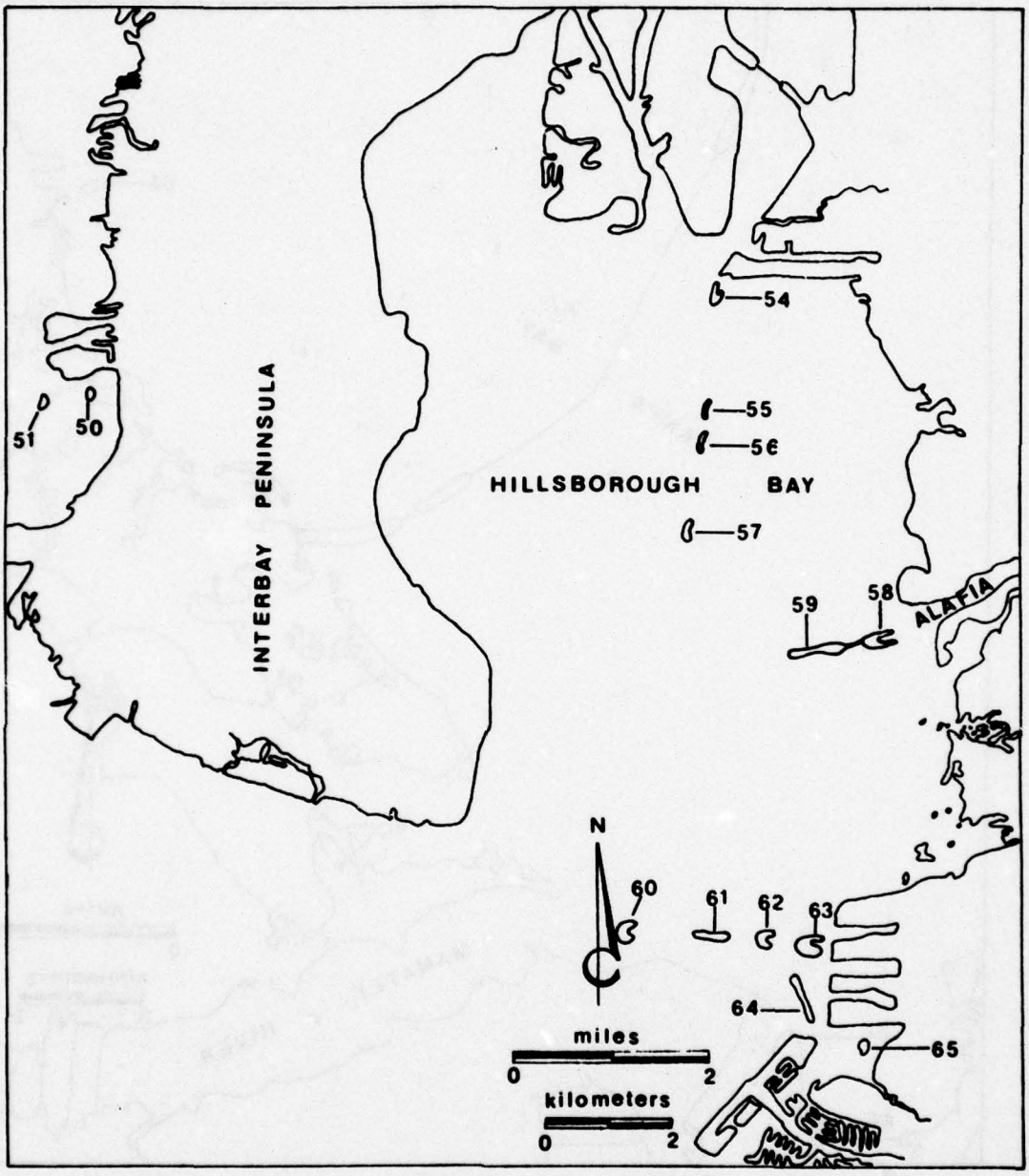

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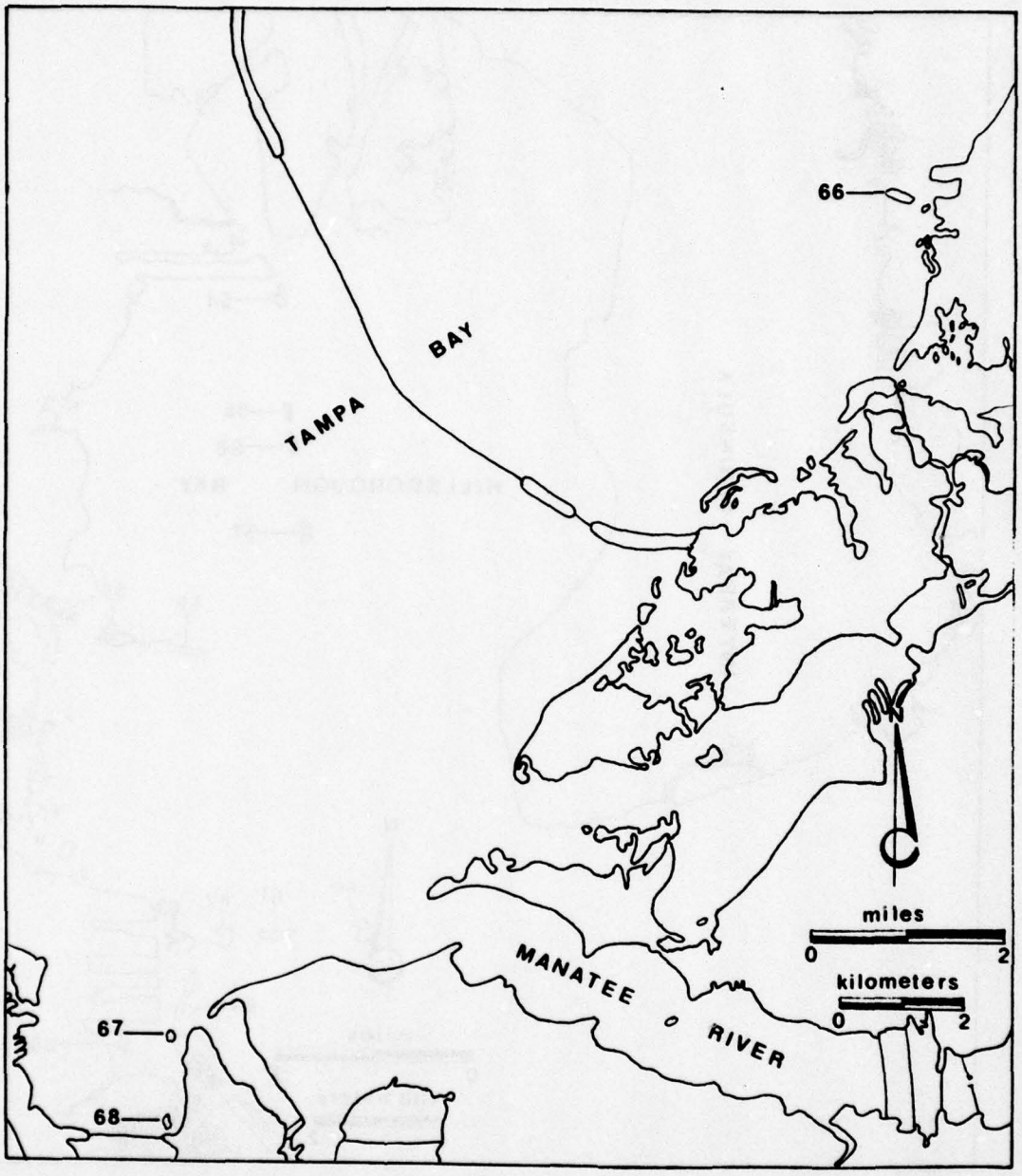

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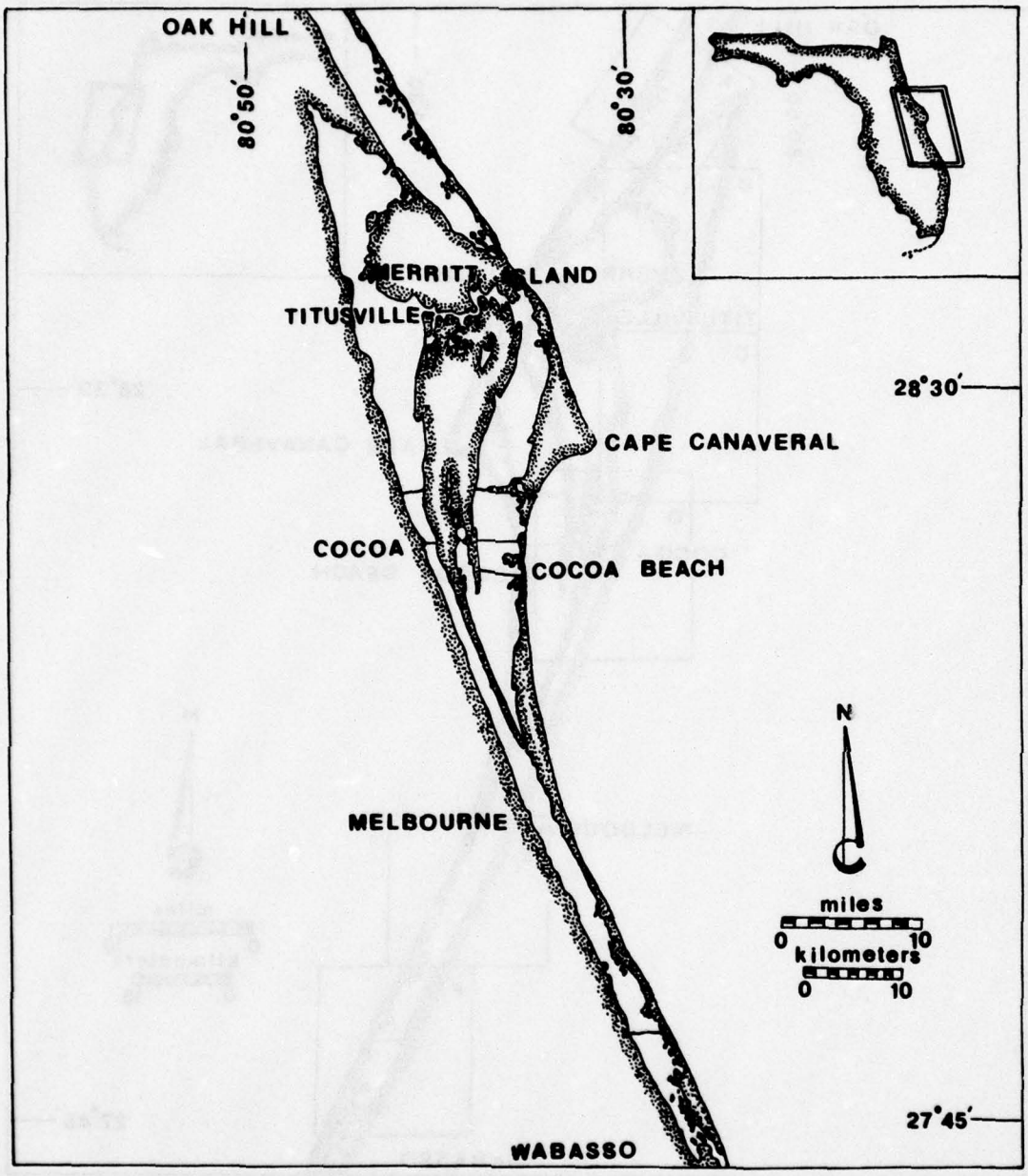

Figure 10. Specific study area II.

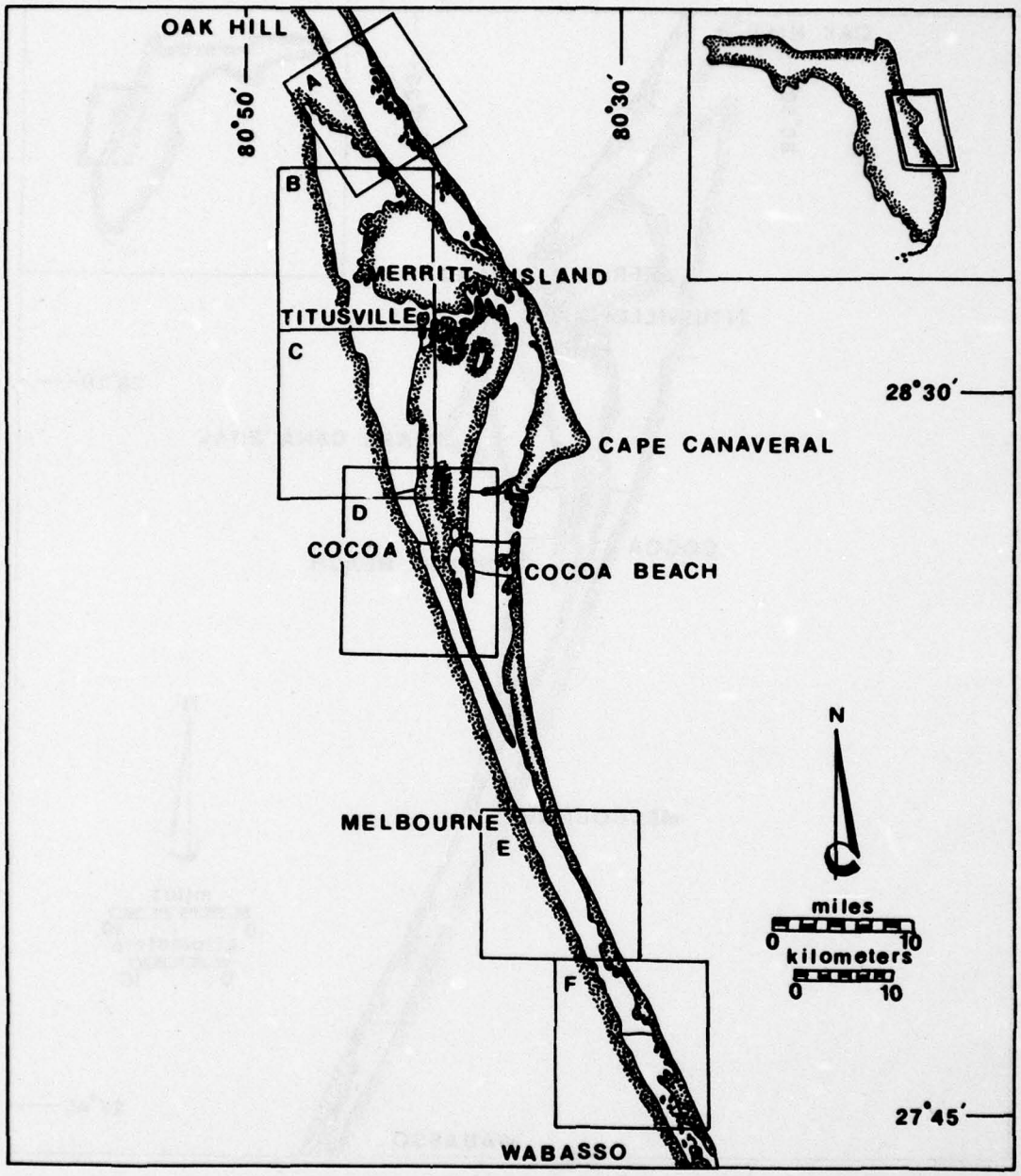

Figure 11. Insets, specific study area II.

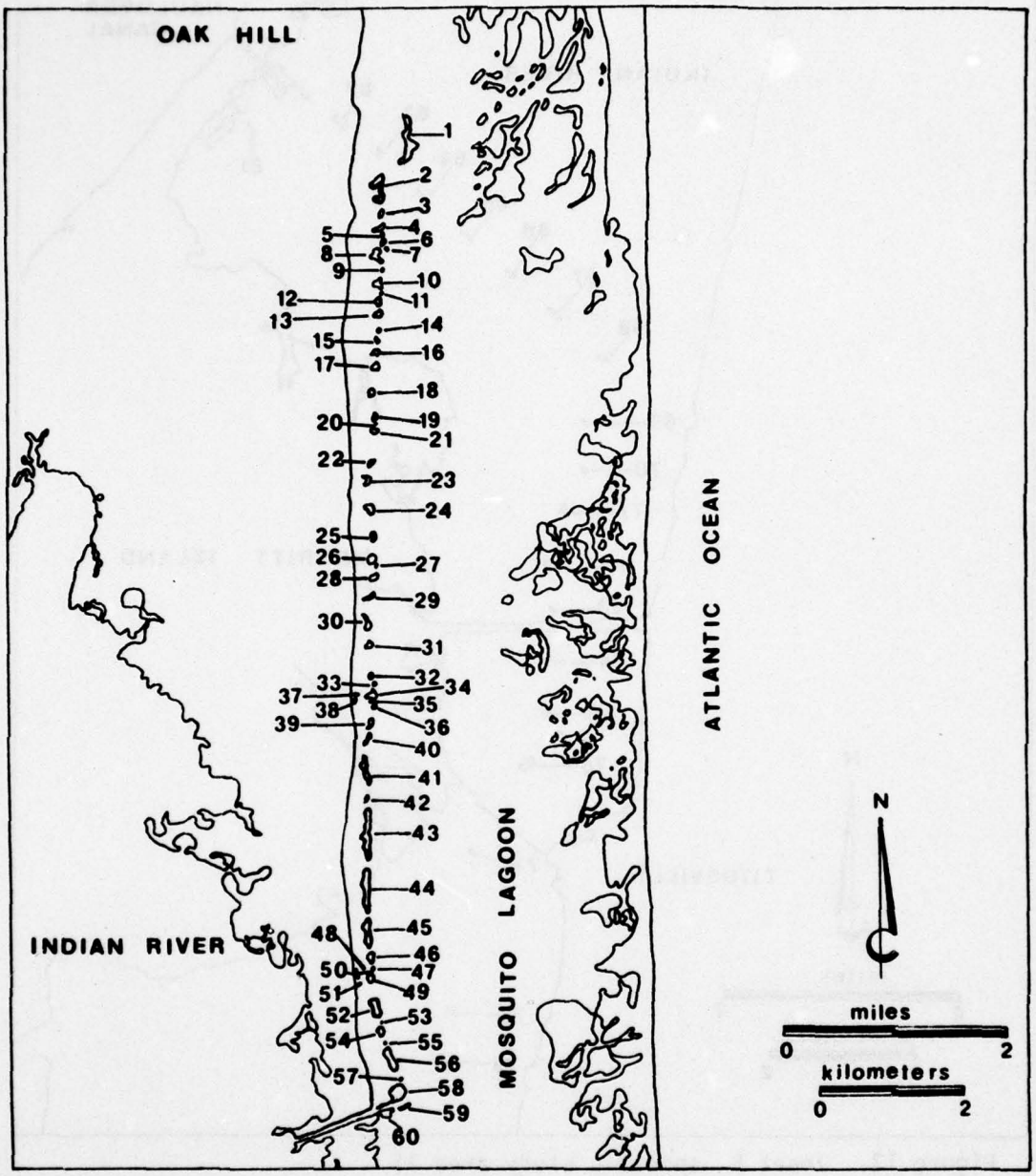

Figure 12. Inset A, specific study area II.

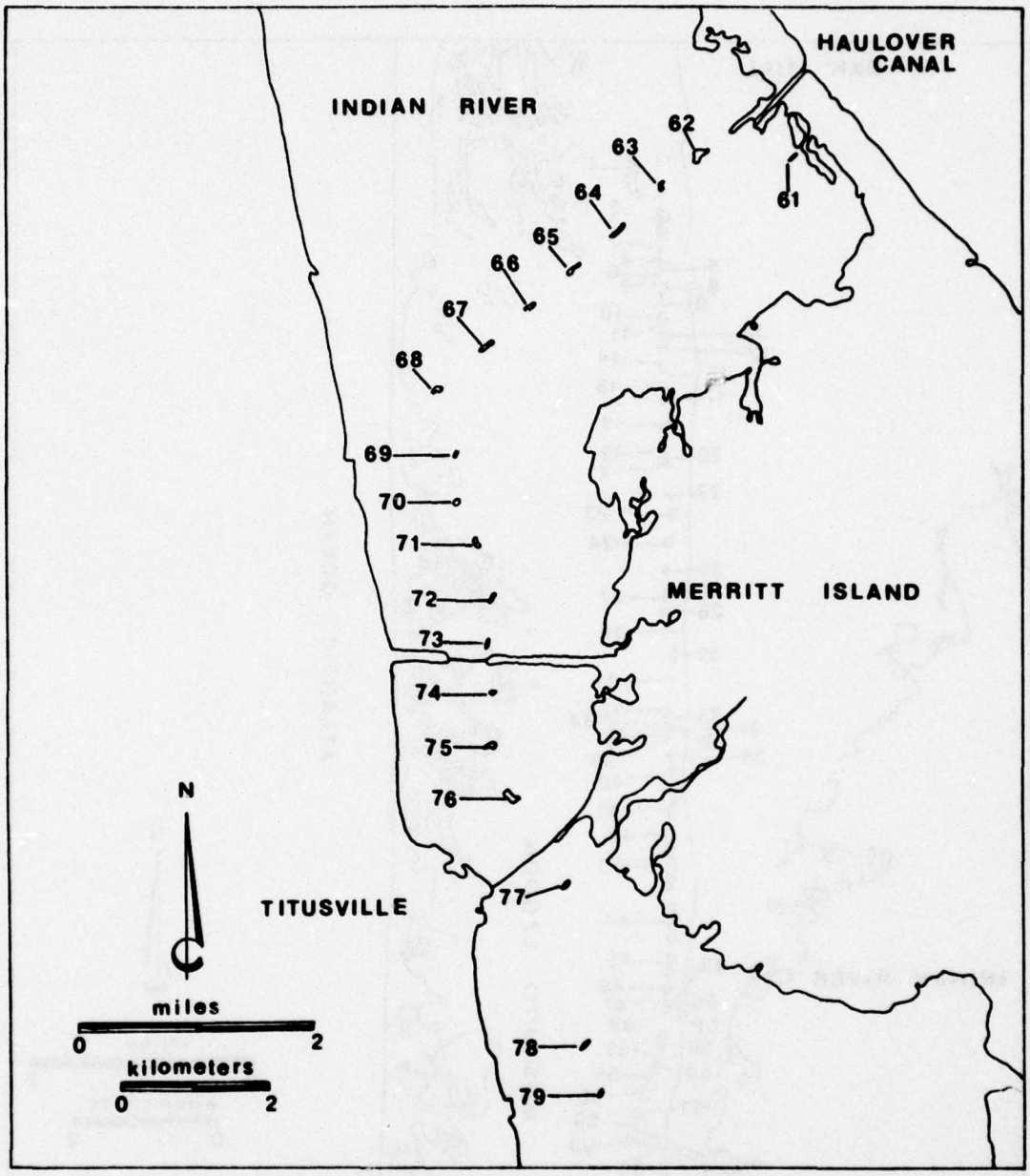

Figure 13. Inset B, specific study area II.

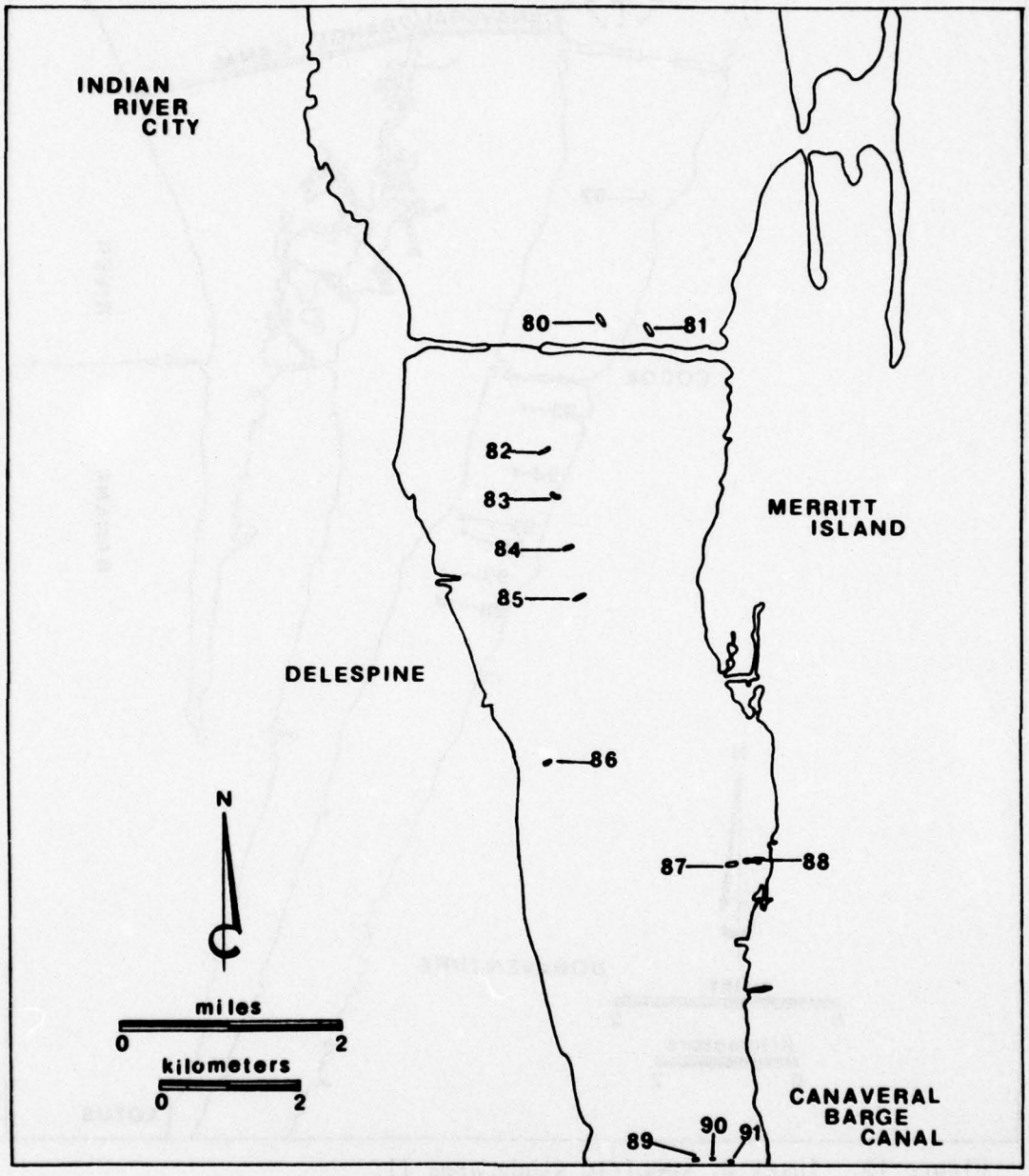

Figure 14. Inset C, specific study area II.

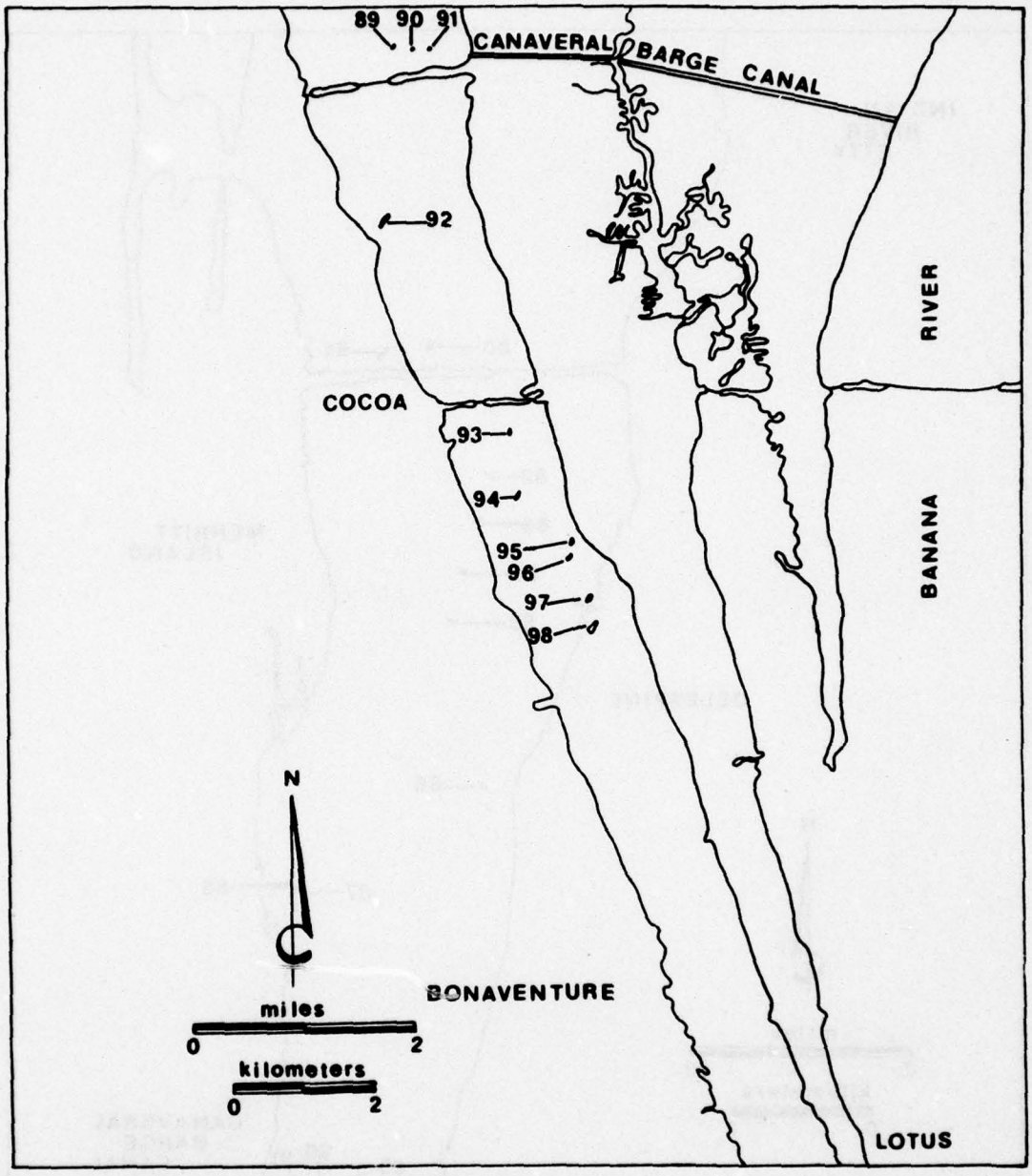

Figure 15. Inset D, specific study area II.

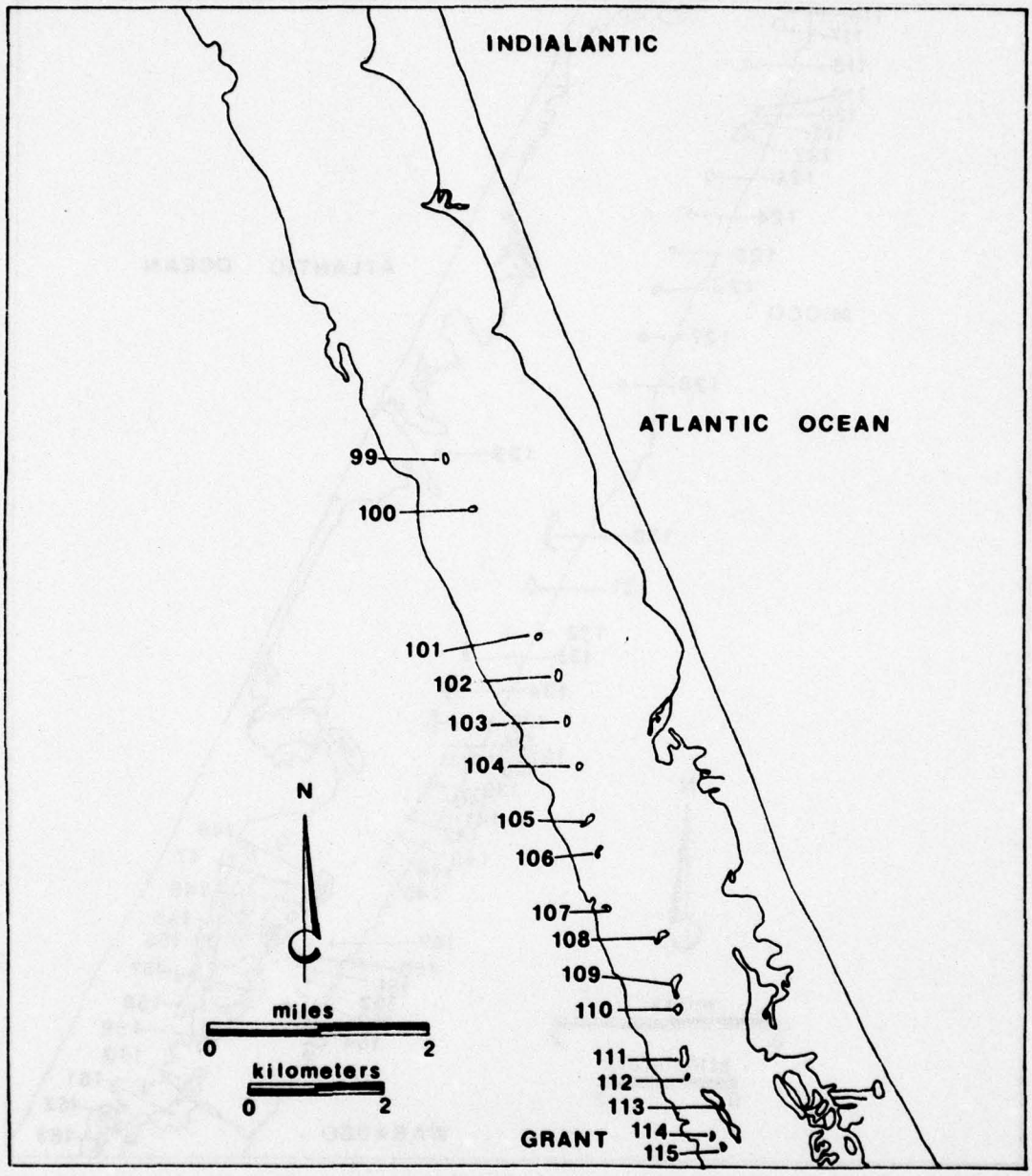

Figure 16. Inset E, specific study area II.

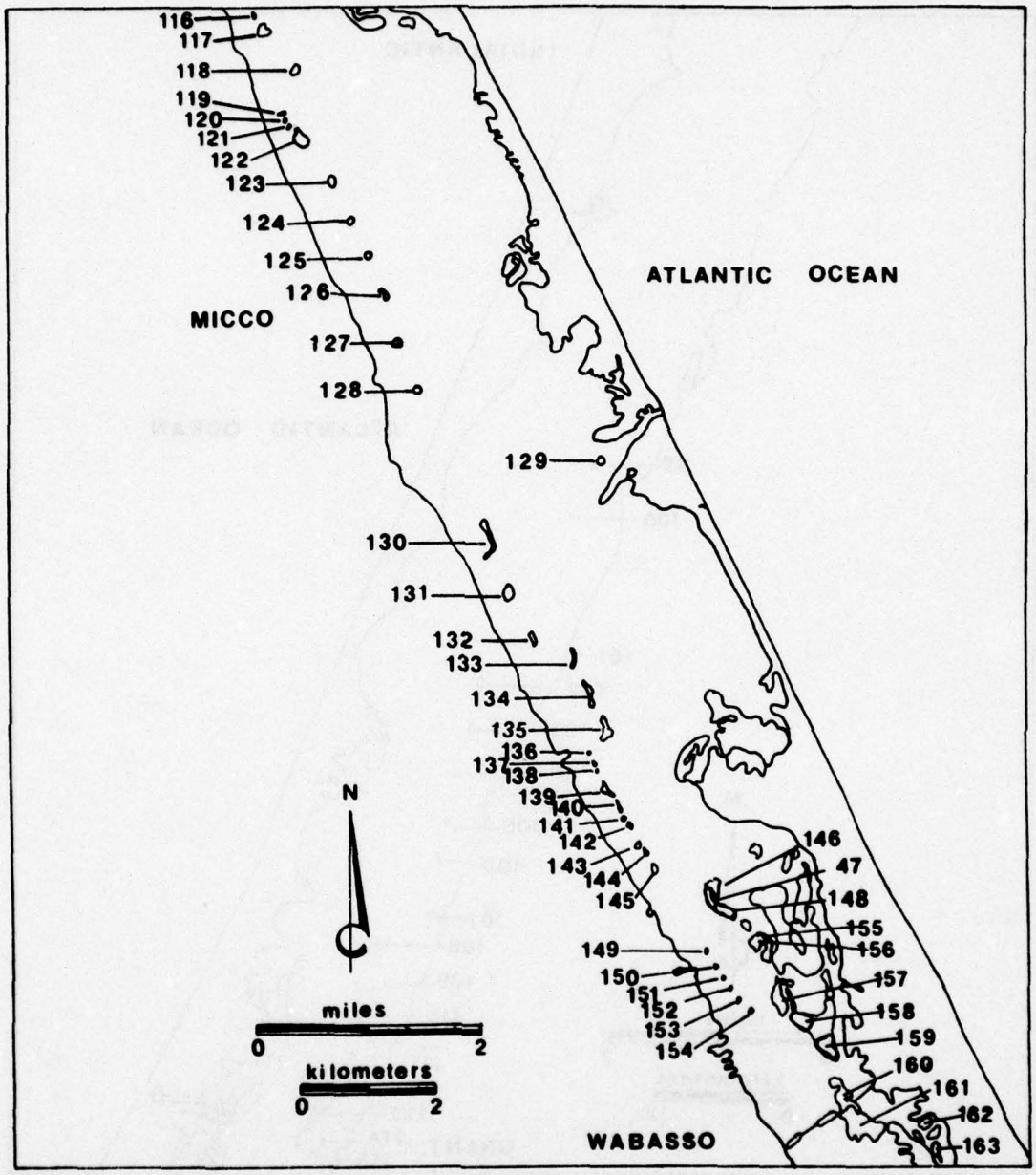

Figure 17. Inset F, specific study area II.

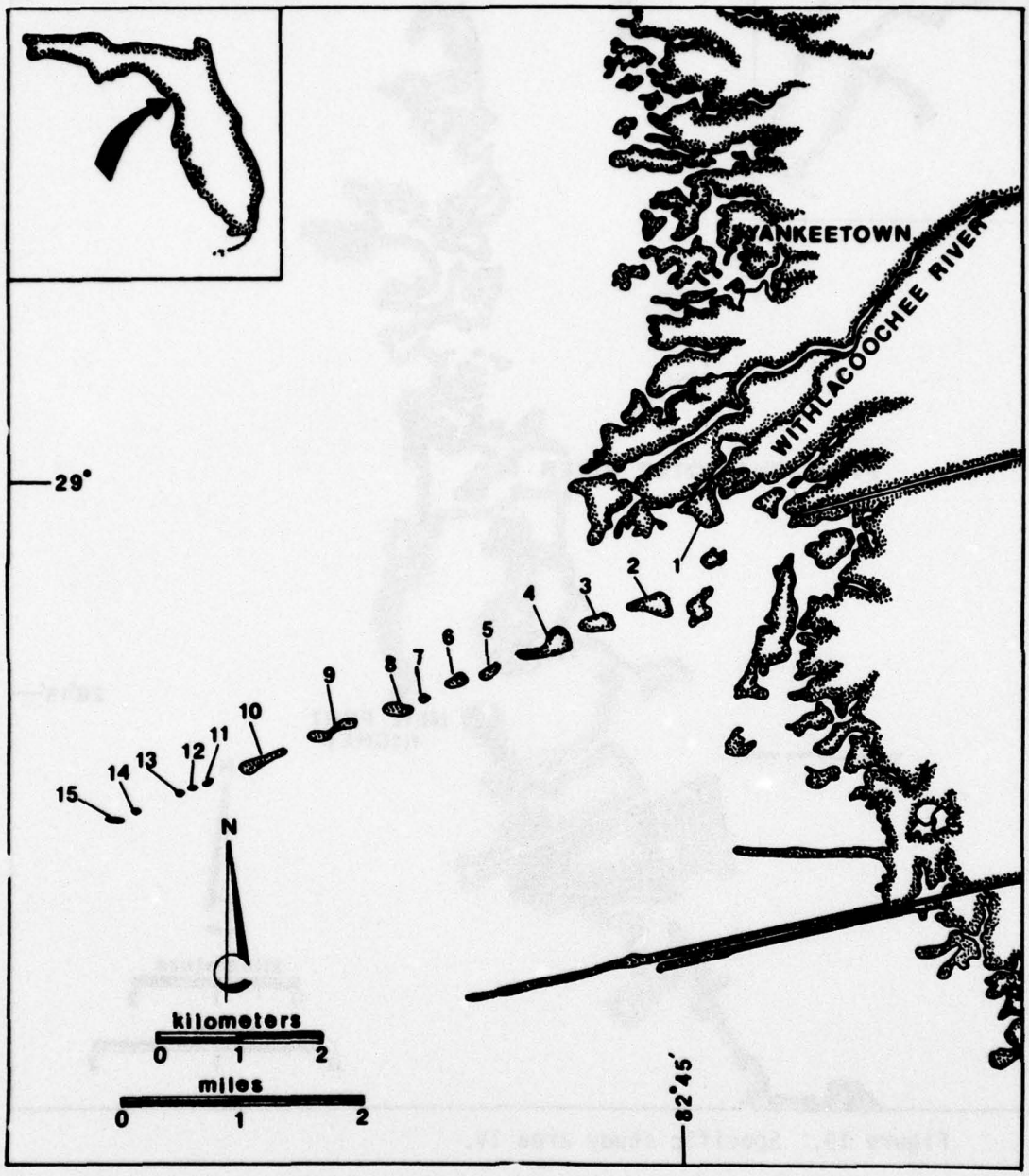

Figure 18. Specific study area III.

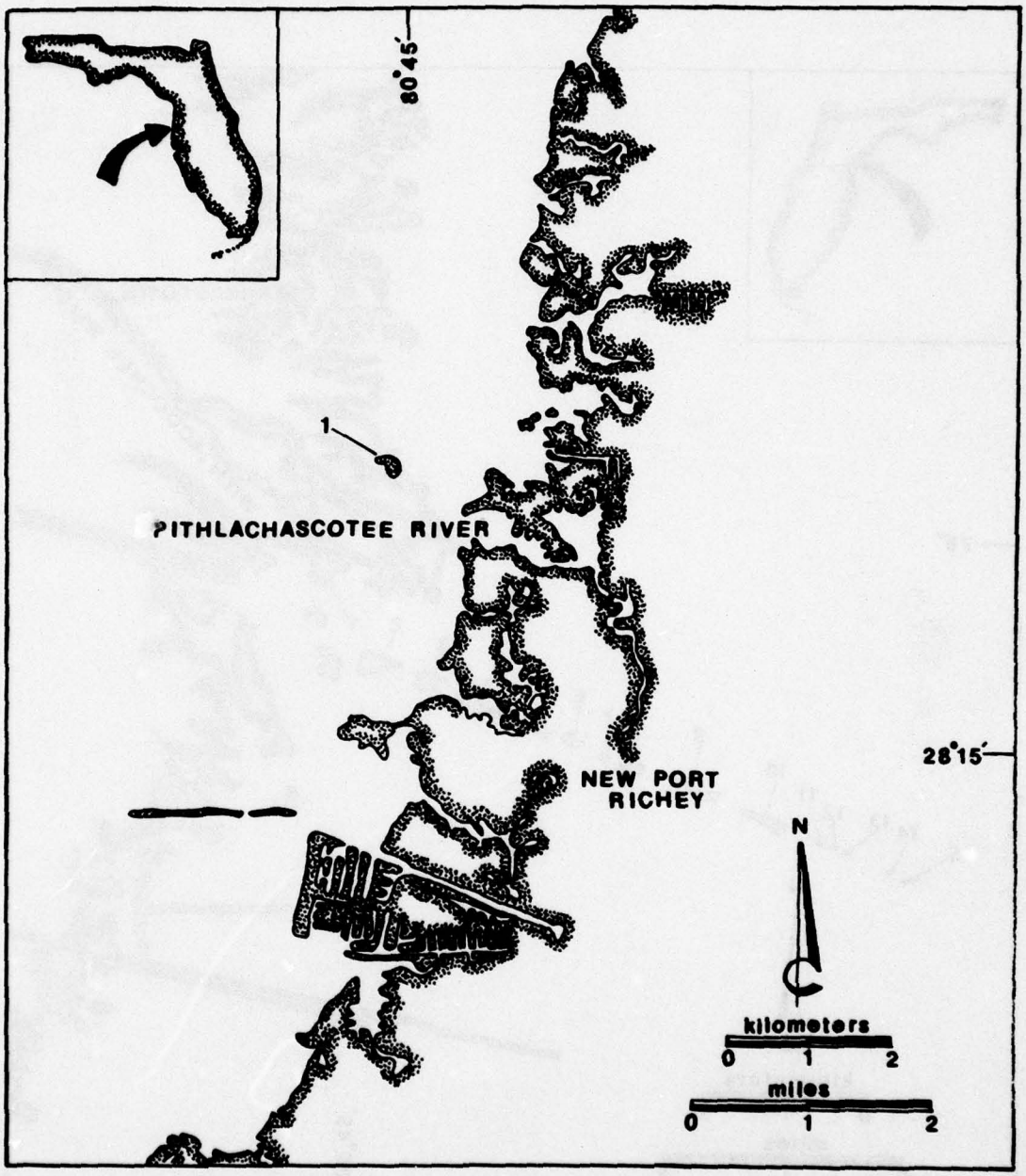

Figure 19. Specific study area IV.

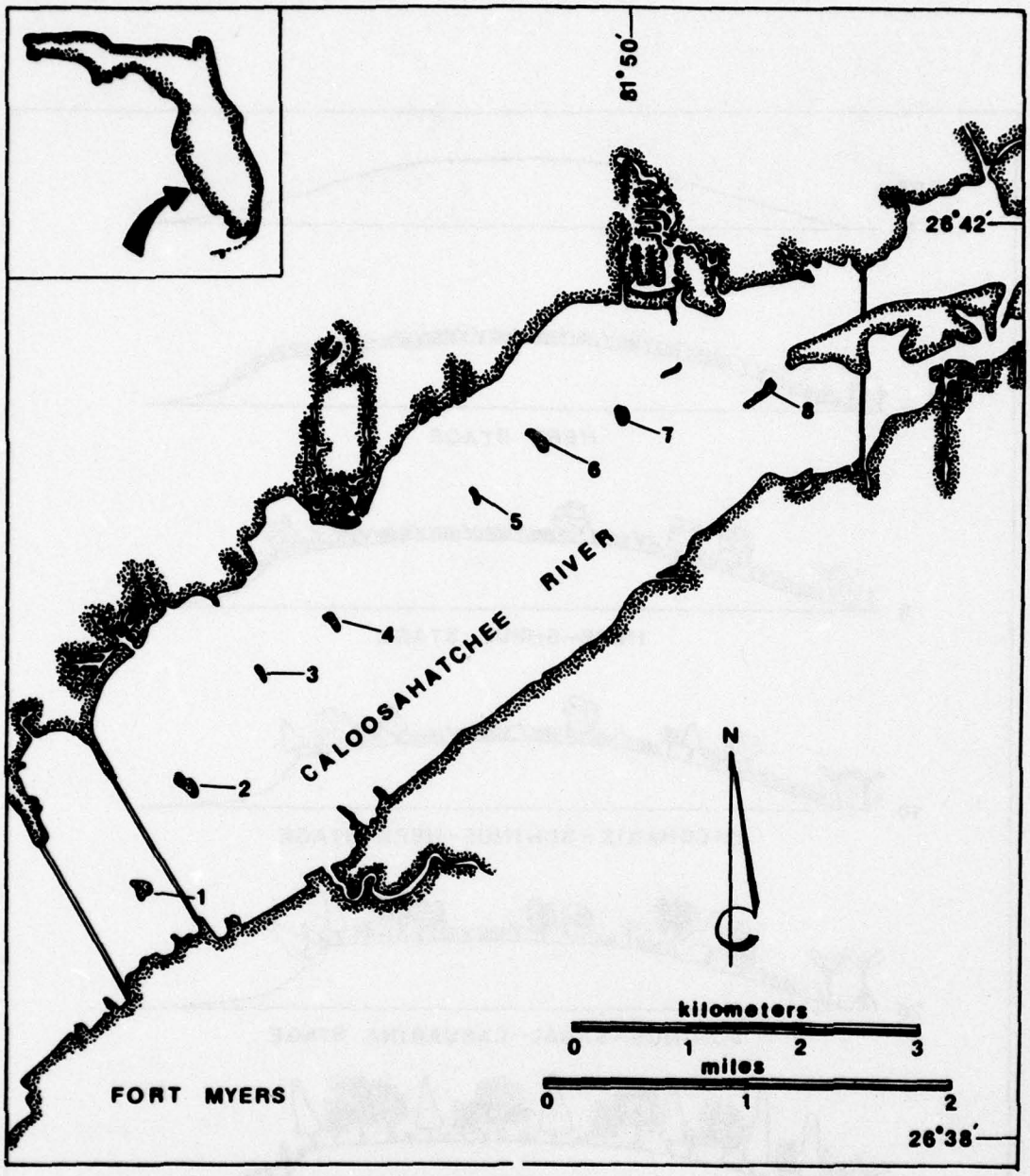

Figure 20. Specific study area V.

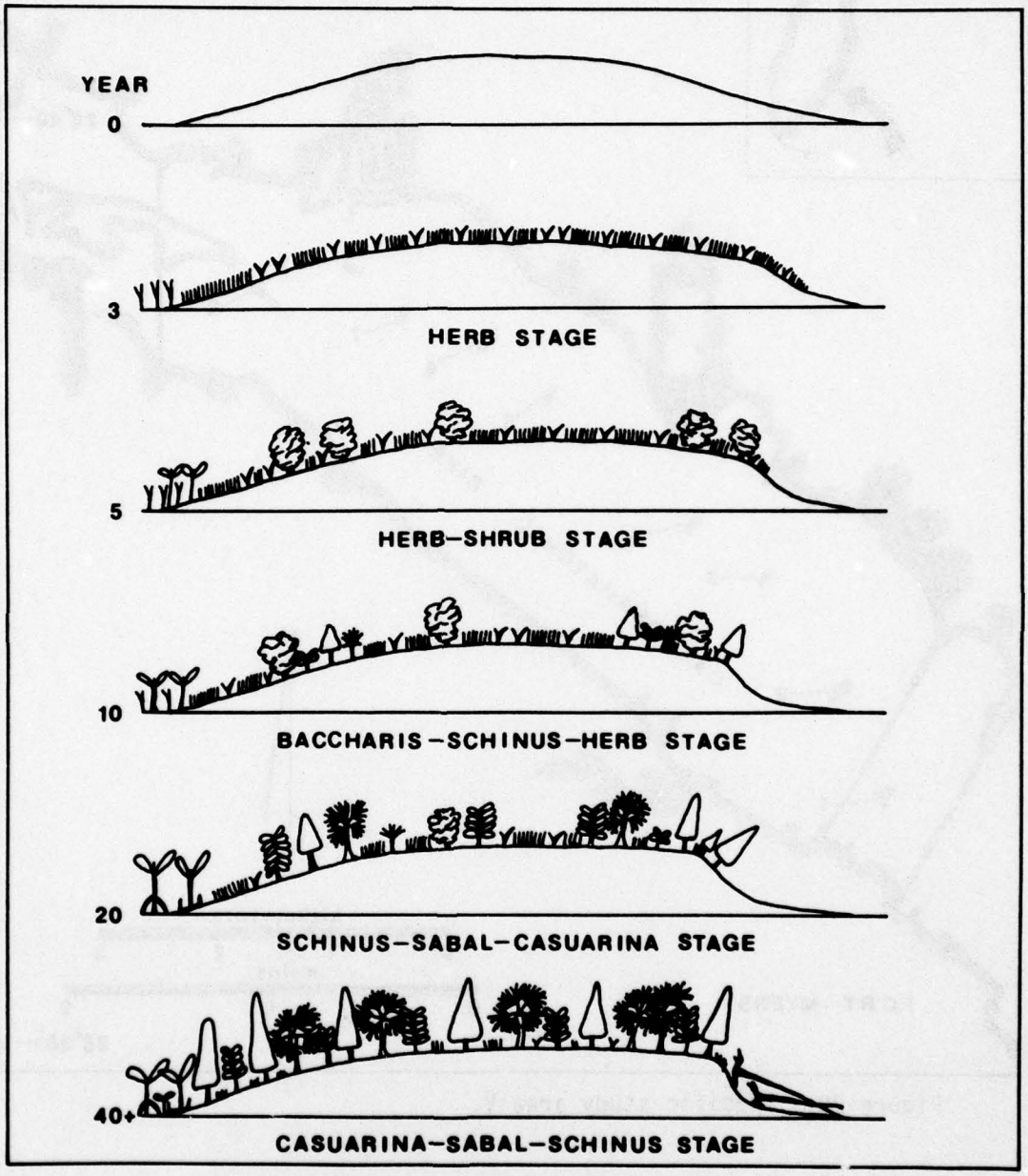

Figure 21. Generalized habitat succession on dredged material islands in Florida. See Figure 22 for vegetation key.

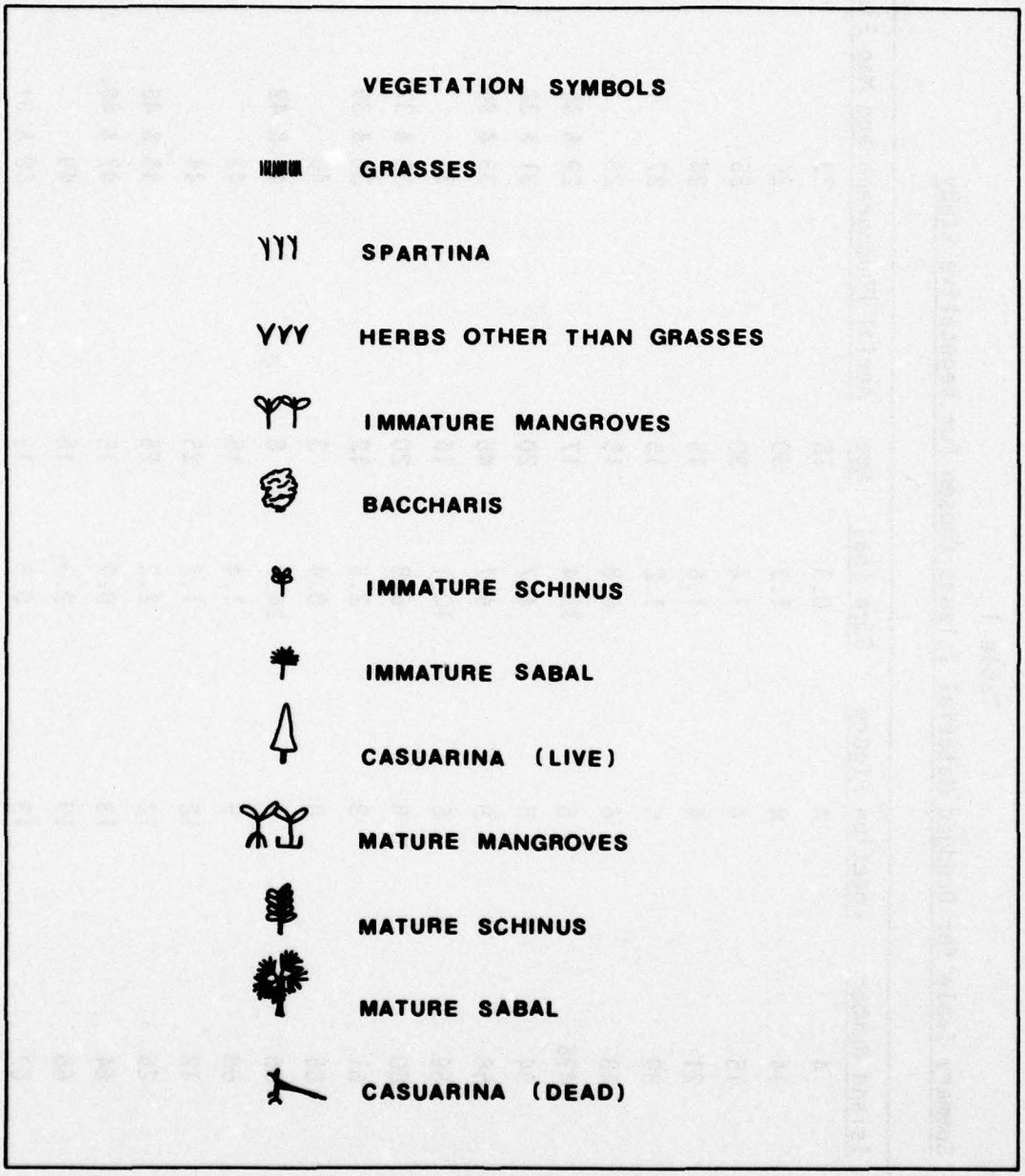

Figure 22. Key to vegetation symbols for Figure 21.

Table 1

Summary Table for Dredged Material Islands Chosen For Vegetative Study

Study Area	Island Number	Location Figure	Size (ha)	Age	Aerial Photograph and Map Figs.
I	4	4	0.3	15	23
I	14	4	1.3	30	24
I	15	4	1.4	30	25
I	21	4	1.6	15	26
I	39	5	1.2	15	27
I	48	6	0.8	15	28
I	49B	6	13.4	17	29 & 30
I	54	8	4.7	20	31 & 32
I	58	8	4.7	46	33 & 34
I	59	8	10.1	16	35
I	60	8	6.8	20	36 & 37
I	61	8	2.3	12	38 & 39
I	65	8	0.4	3	40
I	66	9	24.7	8	41 & 42
I	68	9	1.4	15	43
II	12	12	1.2	25	44
II	26	12	2.2	25	45 & 46
II	64	13	0.9	15	47 & 48
II	66	13	2.3	15	49
II	67	13	0.5	15	50 & 51

(Continued)

Table 1 (Concluded)

Summary Table for Dredged Material Islands Chosen For Vegetative Study

Study Area	Island Number	Location Figure	Size (ha)	Age	Aerial Photograph and Map Figs.
II	80	14	1.8	10	52
II	87	14	1.4	40	53
II	88	14	2.4	40	54 & 55
II	89	14	4.5	14	56 & 57
II	91	14	1.8	14	58
II	97	15	0.9	14	59
II	98	15	1.9	14	60
II	125	17	1.3	20	61
II	128	17	1.4	20	62
II	129	17	1.2	3	63
II	152	17	0.5	20	64
II	153	17	0.6	20	65
III	7	18	0.8	12	66
III	8	18	2.5	12	67
III	12	18	0.1	12	68
III	13	18	0.2	12	69
IV	1	19	1.0	4	70
V	1	20	1.0	40	71 & 72
V	4	20	0.1	3	73
V	7	20	0.9	3	74 & 75

Table 2

Key to Vegetation Maps (Figures 23-75)

A	Atriplex arenaria
An	Andropogon virginicus
B	Baccharis sp.
Ba	Batis maritima
Bi	Bidens pilosa
Bo	Borrichia frutescens
B Sd	Bare sand
C	Casuarina equisetifolia
*	Single Casuarina equisetifolia
Ca	Catharanthus roseus
Ce	Cenchrus sp.
Ch	Chloris sp.
Co	Commelina erecta
Con	Conocarpus erecta
D	Distichlis spicata (found on island but not in transects)
Dal	Dalbergia ecastophyllum
Do	Dodonaea viscosa
Eu	Eupatorium sp.
H	Heterotheca subaxillaris
He	Heliotropium sp.
Herb	Herbaceous mixture other than grasses
I	Iva sp
Ir	Iresine celosia
J	Juniperus silicicola
L	Lagoon
Lan	Lantana camara
Li	Lippia nodiflora
Ly	Lycium carolinianum

(Continued)

Table 2 (Concluded)

M	Mangroves (Avicennia germinans, Laguncularia racemosa, Rhizophora mangle)
Md	Mud
P	Paspalum vaginatum
Pa	Palms other than Sabal
Ph	Philoxerus vermicularis
Pi	Pinus elliottii
Po	Poaceae - grass mixture
Rh	Rhynchelytrum repens
S	Sabal palmetto
Sal	Salicornia sp
Sam	Sambucus simpsonii
S B	Salt barren
Sc	Schinus terebinthifolius
Scr	Scirpus robustus
Se	Sesuvium portulacastrum
So	Solidago sempervirens
Sp	Spartina sp.
Spo	Sporobolus sp.
Su	Suaeda linearis
Ty	Typha sp. (found on island but not in transects)
U	Uniola paniculata

Table 3

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-4

Study Area: I Island Number: 4

Size: 0.3 ha Age: 15 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=11 rel. freq.	abun.	shrub N=0	tree N=0
Chloris petraea	10	A		
Lepidium virginicum	10	A		
Paspalum vaginatum	55	VA		
Sesuvium portulacastrum	10	A		
Sochus oleraceus	10	A		
Spartina patens	5	U		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

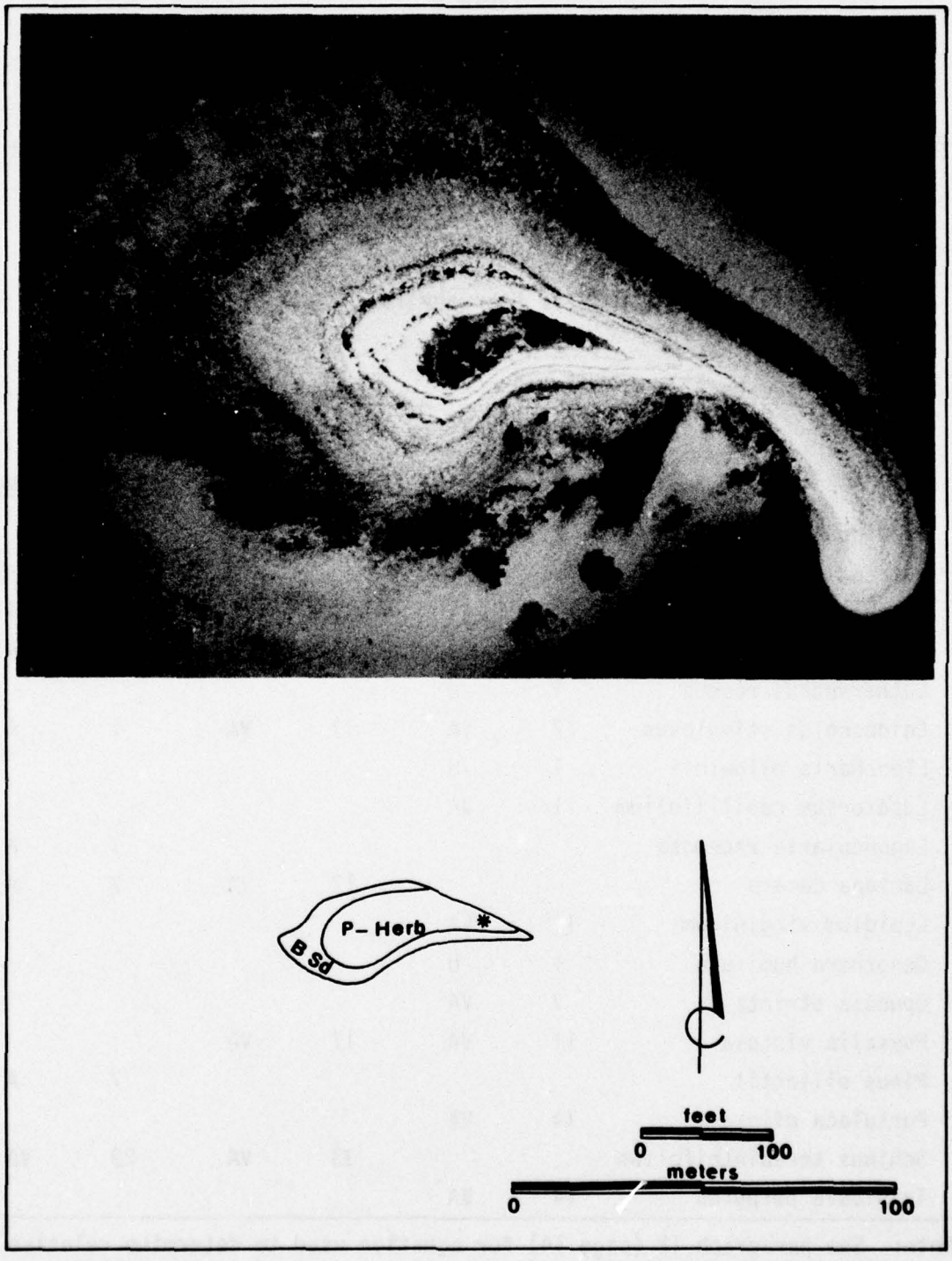

Figure 23. Vertical aerial photograph and vegetation map of dredged material island I-4.

Table 4

General Characteristics and Summary of Vegetation Data
For Dredged Material Island I-14

Study Area: I | Island Number: 14

Size: 1.3 ha | Age: 30 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities					
	herbaceous N=18		shrub N=2		tree N=4	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Ampelopsis arborea	7	A	17	VA		
Avicennia germinans					7	A
Baccharis halimifolia					7	A
Casuarina equisetifolia					22	VA
Catharanthus roseus	1	U				
Cnidoscolus stimulosus	17	VA	17	VA	7	A
Eleocharis baldwinii	1	U				
Eupatorium capillifolium	11	VA				
Laguncularia racemosa					7	A
Lantana camara			17	VA	7	A
Lepidium virginicum	11	VA				
Oenothera humifusa	1	U				
Opuntia stricta	7	VA				
Physalis viscosa	11	VA	17	VA		
Pinus elliottii					7	A
Portulaca pilosa	14	VA				
Schinus terebinthifolius			33	VA	29	VA
Triplasis purpurea	14	VA				

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

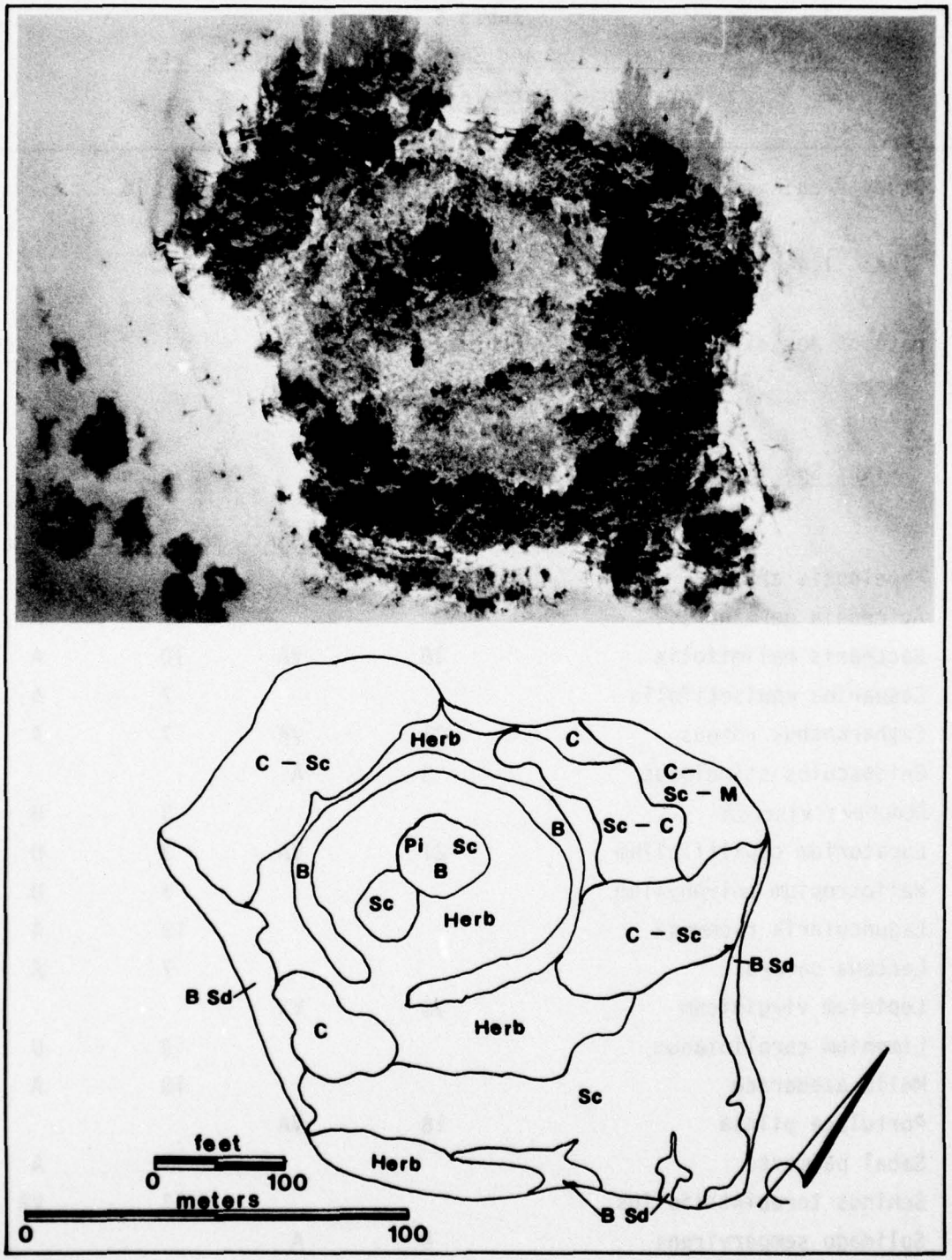

Figure 24. Vertical aerial photograph and vegetation map of dredged material island I-14.

Table 5

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-15

Study Area: I | Island Number: 15

Size: 1.4 ha | Age: 30 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities					
	herbaceous	shrub		tree		
	N=0	N=8		N-13		
		rel. freq.	abun.	rel. freq.	abun.	
Ampelopsis arborea		5	A	3	U	
Avicennia germinans				7	A	
Baccharis halimifolia		18	VA	10	A	
Casuarina equisetifolia				7	A	
Catharanthus roseus		21	VA	7	A	
Cnidosculus stimulosus		3	A			
Dodonaea viscosa				3	U	
Eupatorium capillifolium		21	VA	3	U	
Heliotropium polyphyllum				3	U	
Laguncularia racemosa				13	A	
Lantana camara				7	A	
Lepidium virginicum		10	VA			
Limonium carolinianum				3	U	
Melia azedarach				10	A	
Portulaca pilosa		18	VA			
Sabal palmetto				7	A	
Schinus terebinthifolius				13	VA	
Solidago sempervirens		5	A			
Sophora tomentosa				3	U	

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

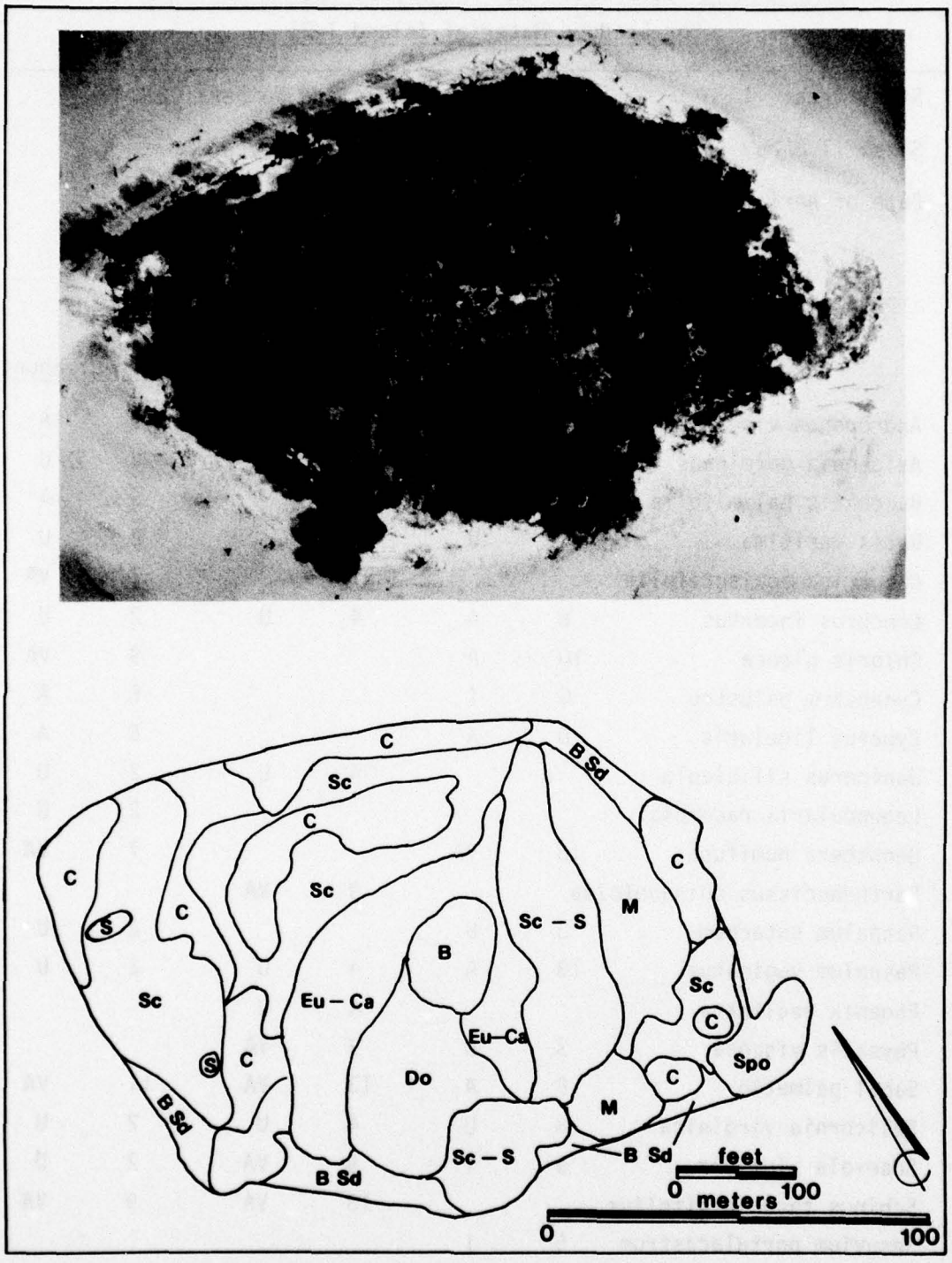

Figure 25. Vertical aerial photograph and vegetation map of dredged material island I-15.

Table 6

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-21

Study Area: I — Island Number: 21

Size: 1.6 ha — Age: 15 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=20 rel.freq.	abun.	shrub N=4 rel.freq.	abun.	tree N=7 rel.freq.	abun.
Andropogon virginicus			13	VA	5	A
Avicennia germinans					2	U
Baccharis halimifolia					5	A
Batis maritima	3	U			2	U
Casuarina equisetifolia					7	VA
Cenchrus incertus	8	A	4	U	2	U
Chloris glauca	10	A			9	VA
Cynanchum palustre	5	I			5	A
Cyperus ligularis	8	A			5	A
Juniperus silicicola			4	U	2	U
Laguncularia racemosa					2	U
Oenothera humifusa	18	VA			7	VA
Parthenocissus quinquefolia			9	VA		
Paspalum setaceum	3	U			2	U
Paspalum vaginatum	13	A	4	U	2	U
Phoenix reclinata			4	U		
Physalis viscosa	3	U	9	VA		
Sabal palmetto	8	A	13	VA	11	VA
Salicornia virginica	3	U	4	U	2	U
Scaevola plumieri	5	I	9	VA	2	U
Schinus terebinthifolius			13	VA	9	VA
Sesuvium portulacastrum	5	I				

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 6 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Solidago sempervirens			9	VA	9	VA
Spartina alterniflora	8	A				
Sporobolus virginicus	3	U				
Stenotaphrum secundatum					5	A
Suaeda linearis	3	U			5	A
Washingtonia robusta			4	U		

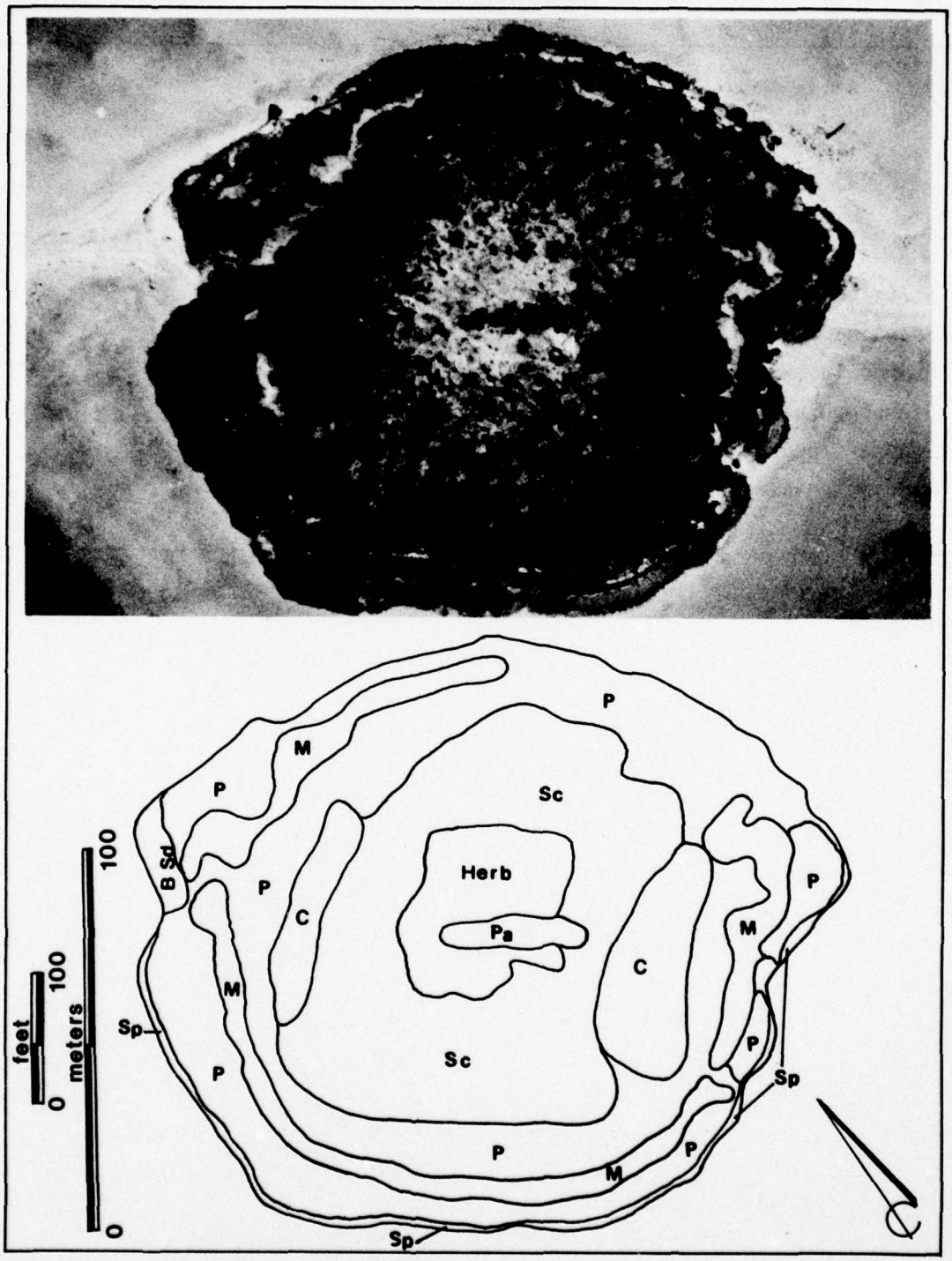

Figure 26. Vertical aerial photograph and vegetation map of dredged material island I-21

Table 7

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-39

Study Area: I Island Number: 39

Size: 1.2 ha Age: 15 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities					
	herbaceous N=5		shrub N=9		tree N=4	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Andropogon virginicus	17	A	11	VA	8	U
Avicennia germinans	6	U	3	U	17	VA
Baccharis halimifolia	11	I	11	VA	8	U
Batis maritima	11	I	6	A		
Casuarina equisetifolia					17	VA
Cenchrus incertus			3	U		
Chamaesyce blodgettii	11	I				
Heliotropium curassavicum					8	U
Iva frutescens			11	VA	8	U
Laguncularia racemosa			6	A	8	U
Lepidium virginicum	17	A	6	A		
Oenothera humifusa	6	U	3	U		
Paspalum vaginatum			6	A		
Rhizophora mangle					8	U
Sabal palmetto			3	U		
Salicornia virginica	11	I	6	A		
Schinus terebinthifolius	6	U	11	VA		
Sesuvium portulacastrum			6	A	8	U
Solidago sempervirens	6	U	9	VA	8	U

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

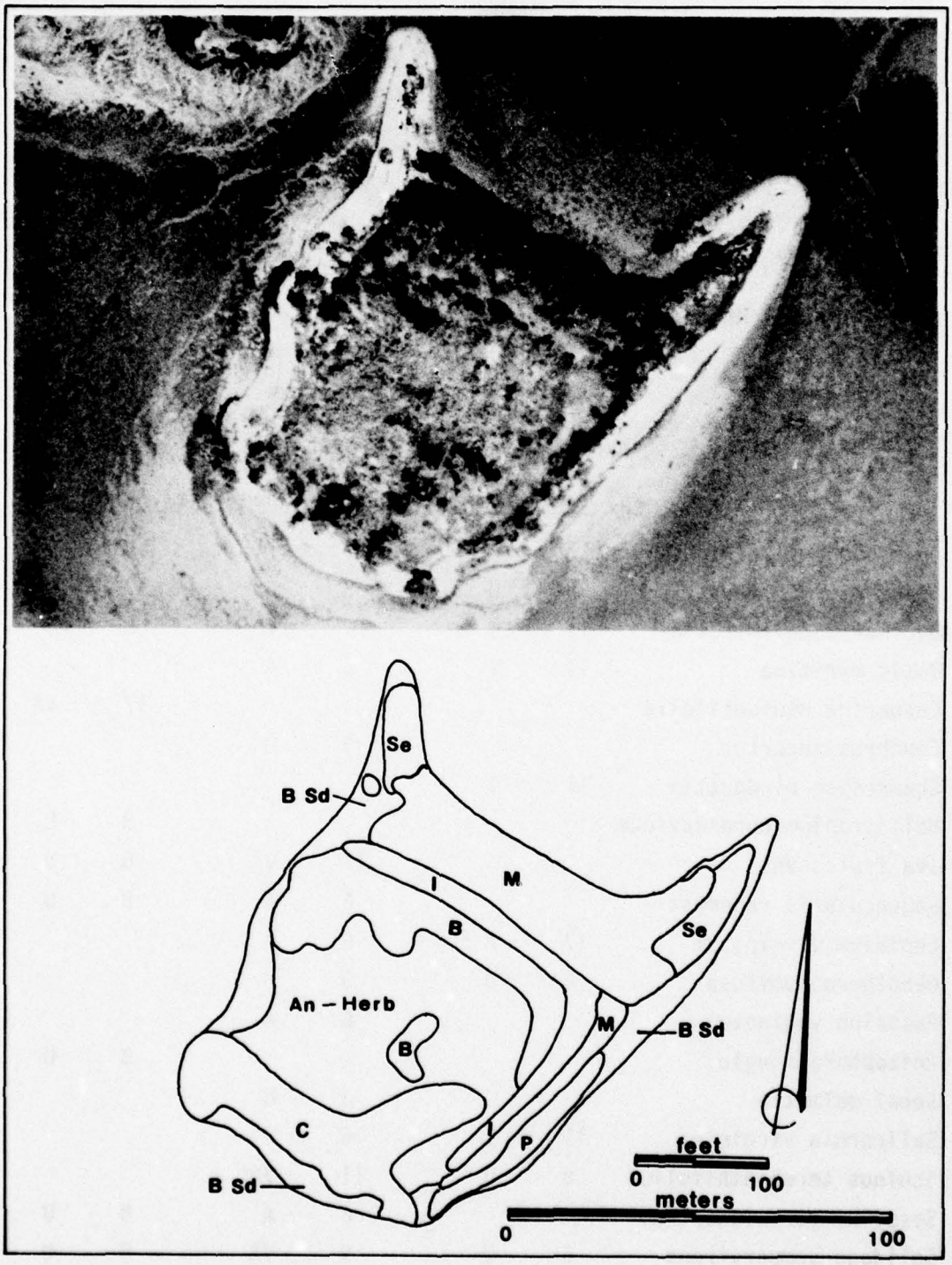

Figure 27. Vertical aerial photograph and vegetation map of dredged material island I-39.

Table 8

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-48

Study Area: I | Island Number: 48

Size: 0.8 ha | Age: 15 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=31 rel. freq.	herbaceous N=31 abun.	shrub N=0	tree N=0
Avicennia germinans	1	U		
Baccharis halimifolia	3	I		
Chloris glauca	3	I		
Cyperus ligularis	8	A		
Fimbristylis spadicea	1	U		
Ipomoea pes-caprae	1	U		
Iva frutescens	1	U		
Lippia nodiflora	16	VA		
Panicum amarum	1	U		
Paspalum vaginatum	37	VA		
Physalis viscosa	3	I		
Sabal palmetto	1	U		
Solidago sempervirens	16	VA		
Suaeda linearis	1	U		
Yucca aloifolia	3	I		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

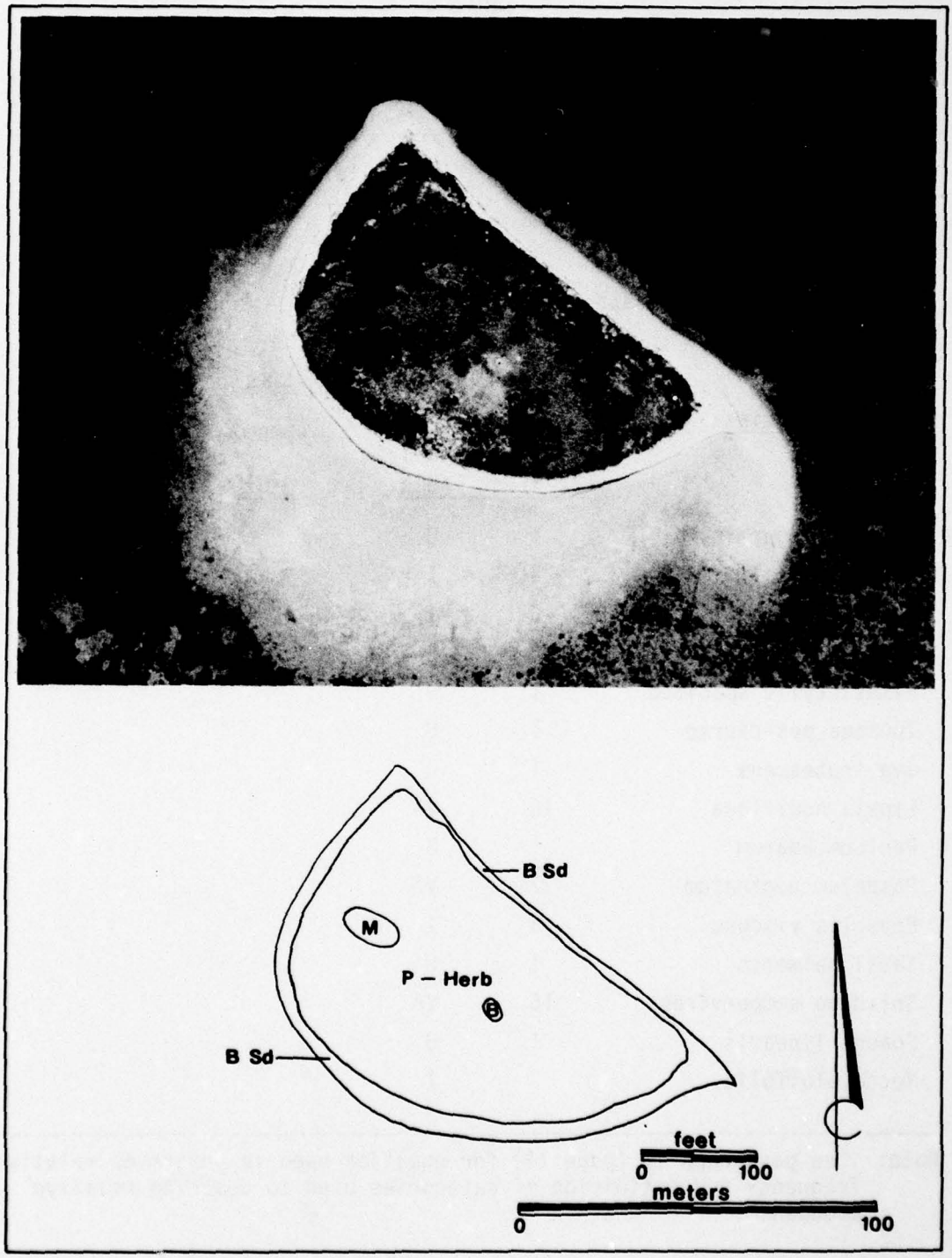

Figure 28. Vertical aerial photograph and vegetation map of dredged material island I-48.

Table 9

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-49B

Study Area: I — Island Number: 49B

Size: 13.4 ha — Age: 17 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=85 rel. freq.	herbaceous N=85 abun.	shrub N=13 rel. freq.	shrub N=13 abun.	tree N=0
Andropogon virginicus	9	A			
Avicennia germinans			5	A	
Baccharis halimifolia	2	I	7	A	
Batis maritima	1	U	5	A	
Bidens pilosa	3	I			
Casuarina equisetifolia	1	U			
Cenchrus pauciflorus	3	I	2	I	
Chloris glauca	10	A			
Cynanchum palustre	1	I	7	A	
Cynodon dactylon	3	I			
Cyperus ligularis			2	I	
Cyperus polystachyos			2	I	
Eupatorium capillifolium	5	I	9	A	
Heterotheca subaxillaris	12	A	5	A	
Ipomoea pes-caprae	2	I			
Iva frutescens			2	I	
Lepidium virginicum	7	A	7	A	
Lippia nodiflora	1	U			
Lycium carolinianum	1	U			
Melothria pendula	3	I			
Oenothera humifusa	7	A			

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 9 (Concluded)

Plant Species	Communities				
	herbaceous		shrub		tree
	rel. freq.	abun.	rel. freq.	abun.	N=0
Paspalum setaceum	2	I			
Paspalum vaginatum	7	A	12	VA	
Philoxerus vermicularis	1	U			
Physalis viscosa	18	VA	12	VA	
Phytolacca americana	1	U			
Sabal palmetto			7	A	
Schinus terebinthifolius	1	I	5	A	
Sesuvium portulacastrum			2	U	
Solidago sempervirens			7	A	
Spartina patens	1	I			
Suaeda linearis	2	I	2	U	

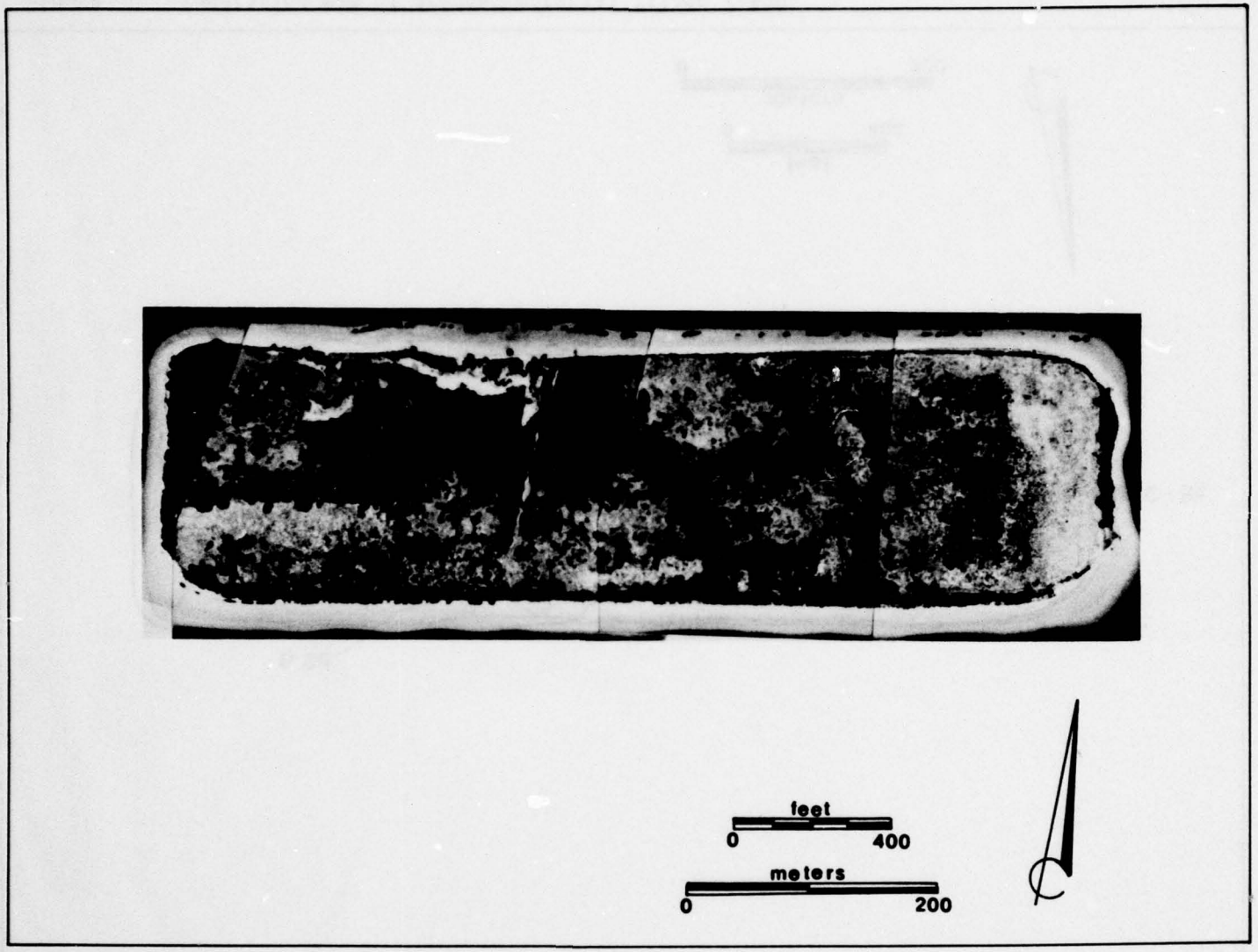

Figure 29. Vertical aerial photograph of dredged material island I-49B.

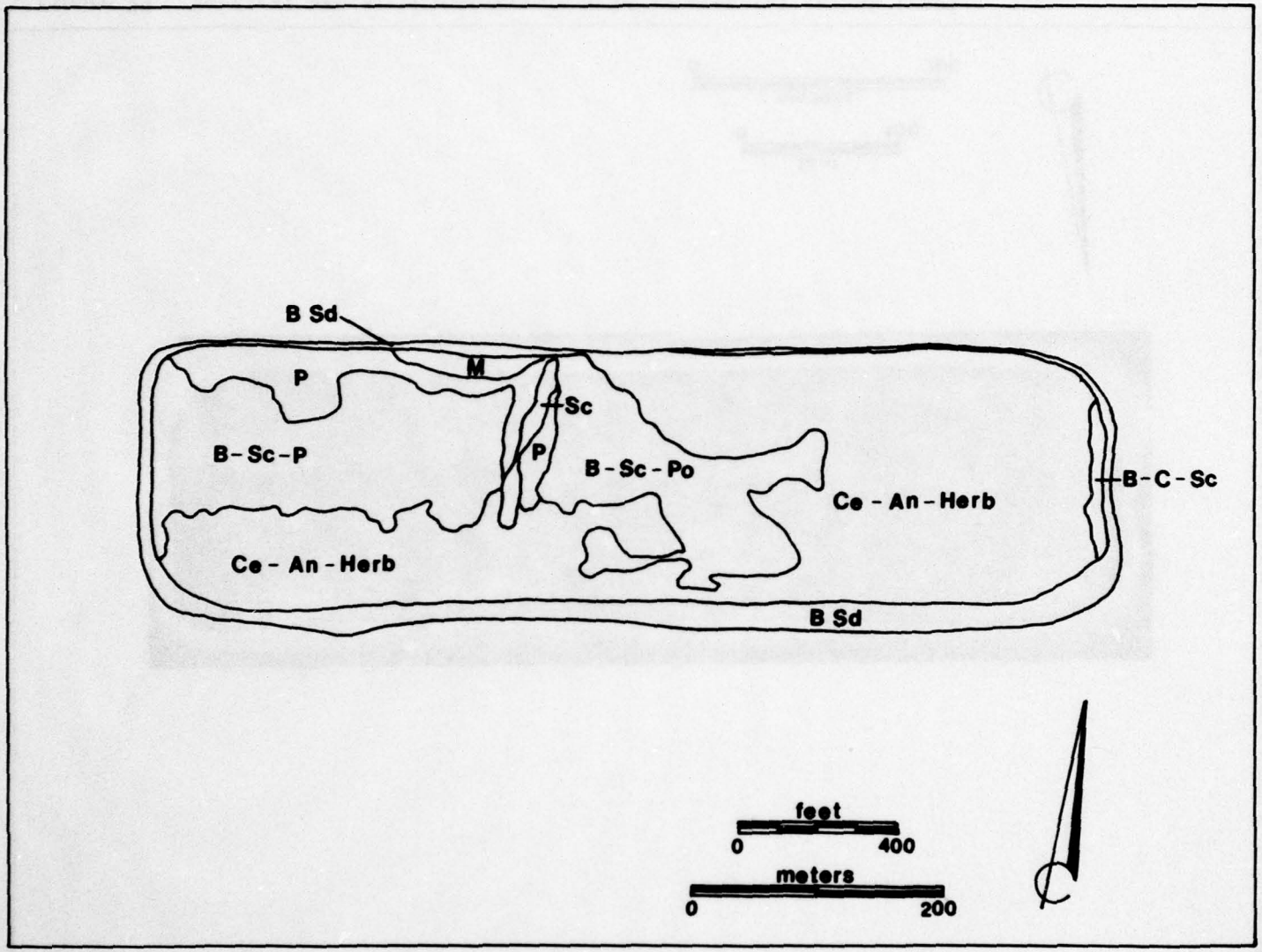

Figure 30. Vegetation map of dredged material island I-49B.

Table 10

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-54

Study Area: I | Island Number: 54

Size: 4.7 ha | Age: 20 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=0	shrub N=35 rel. freq.	shrub N=35 abun.	tree N=0
Andropogon virginicus		5	A	
Avicennia germinans		6	A	
Baccharis halimifolia		16	VA	
Canavalia rosea		1	I	
Cyperus ligularis		1	I	
Eupatorium capillifolium		8	A	
Heterotheca subaxillaris		2	I	
Iva frutescens		4	A	
Laguncularia racemosa		3	A	
Lantana camara		16	VA	
Lippia nodiflora		1	U	
Opuntia stricta		2	I	
Paspalum vaginatum		2	I	
Philoxerus vermicularis		2	I	
Physalis viscosa		1	U	
Phytolacca americana		1	U	
Pluchea purpurascens		1	U	
Portulaca pilosa		5	A	
Rhizophora mangle		1	I	
Rhynchelytrum repens		5	A	
Schinus terebinthifolius		4	A	

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 10 (Concluded)

Plant Species	herbaceous	shrub		tree
	N=0	rel. freq.	abun.	N=0
Sesuvium portulacastrum		1	U	
Solidago sempervirens		9	VA	
Spartina alterniflora		5	A	
Sporobolus poiretii		1	U	
Vigna luteola		1	U	

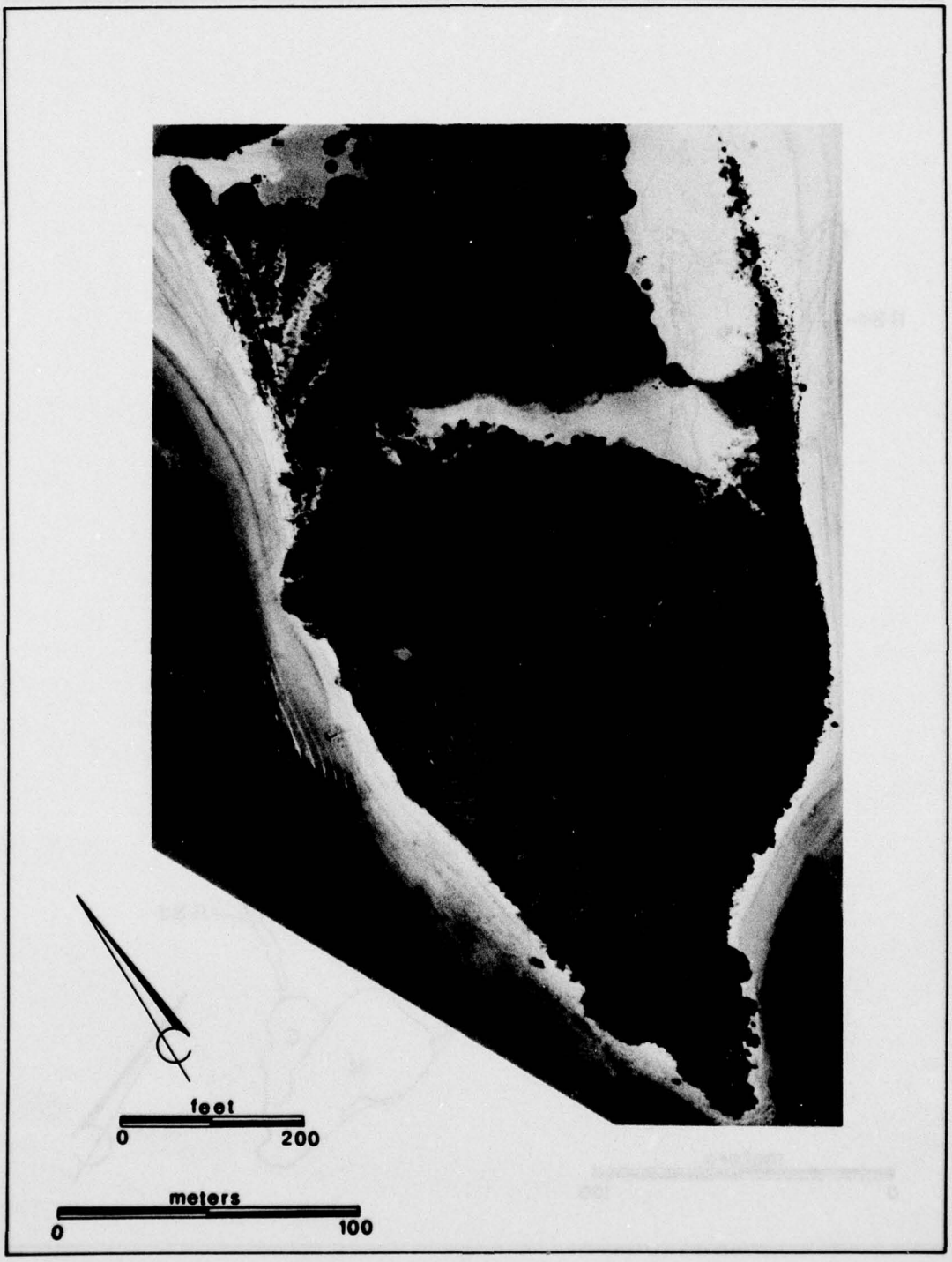

Figure 31. Vertical aerial photograph of dredged material island I-54.

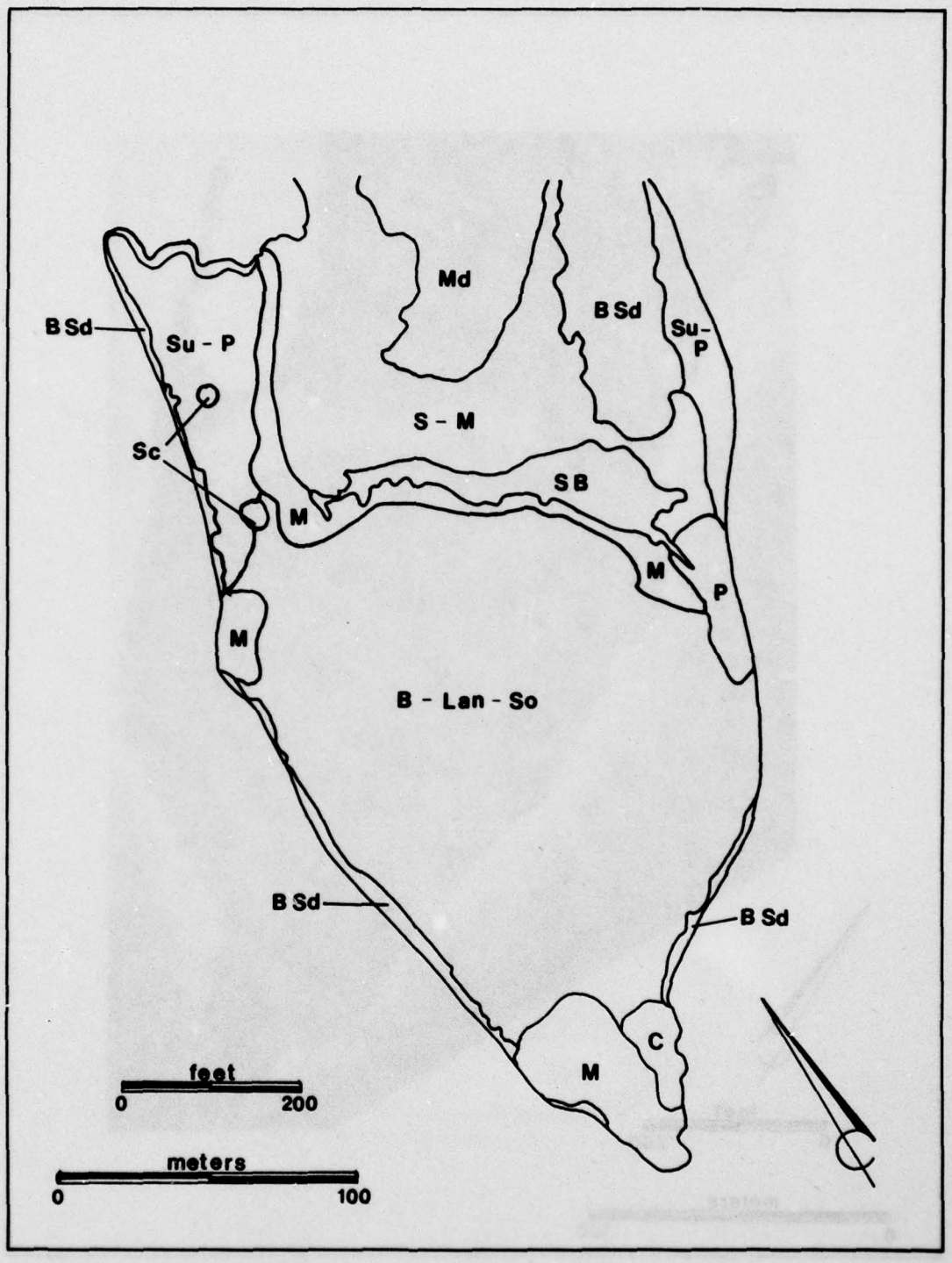

Figure 32. Vegetation map of dredged material island I-54.

Table 11

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-58

Study Area: I | Island Number: 58

Size: 4.7 ha | Age: 46 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities					
	herbaceous N=25		shrub N=11		tree N=25	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Ambrosia artemisiifolia	14	VA	15	VA		
Ampelopsis arborea	2	U				
Avicennia germinans					24	VA
Baccharis halimifolia			2	U		
Bidens pilosa	32	VA	15	VA		
Caesalpinia crista			8	VA		
Citrus sinensis					2	U
Commelina erecta	5	A	12	VA		
Ficus aurea					2	U
Heterotheca subaxillaris	2	U				
Ipomoea alba	2	U				
Ipomoea sagittata					3	I
Iva frutescens			4	A	6	A
Laguncularia racemosa					14	VA
Lantana camara	2	U	13	VA	11	A
Morus rubra					3	I
Oenothera humifusa	2	U				
Oenothera laciniata	2	U	4	A		
Parietaria praetermissa			4	A		
Paspalum setaceum	2	U				

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 11 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Paspalum vaginatum	3	I				
Passiflora lutea	2	U	4	A	3	I
Physalis viscosa	17	VA	6	A		
Phytolacca americana			4	A	3	I
Portulaca pilosa	2	U				
Rhizophora mangle					14	VA
Sabal palmetto			9	VA	15	VA
Sambucus simpsonii	8	A				
Schinus terebinthifolius					2	U
Solidago sempervirens			2	U		
Spartina patens	6	A				
Sporobolus poiretii	2	U	2	U		

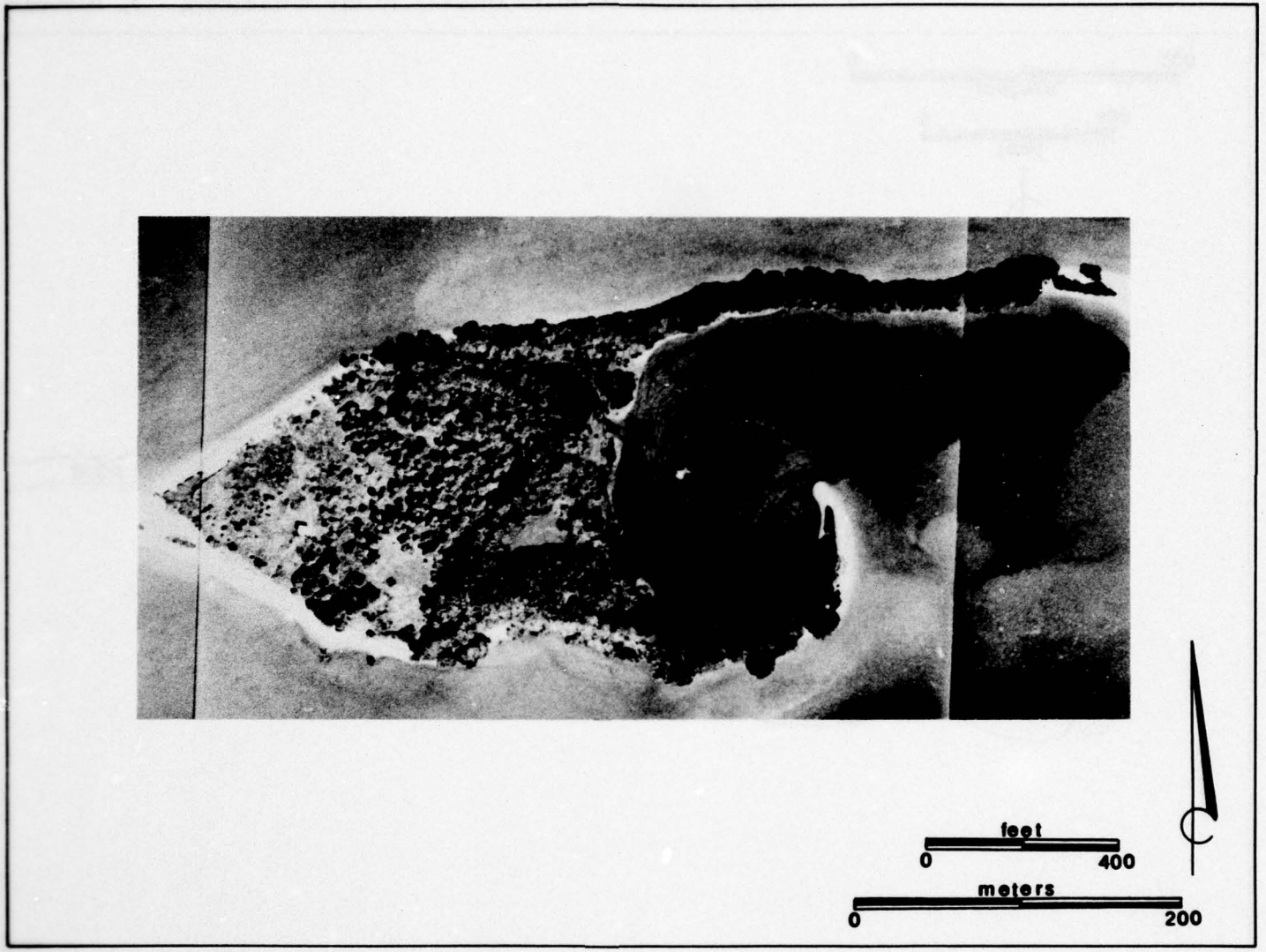

Figure 33. Vertical aerial photograph of dredged material island I-58.

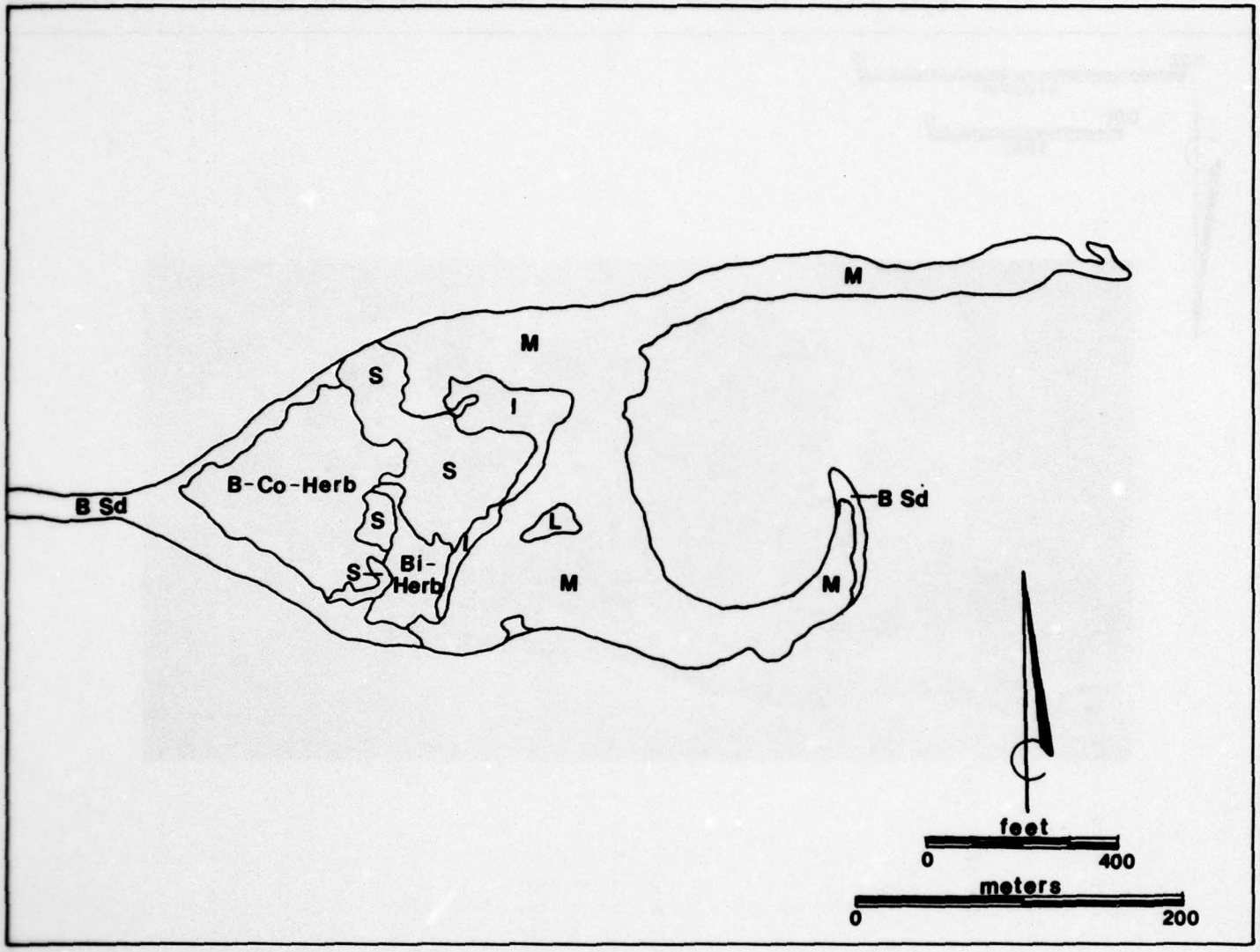

Figure 34. Vegetation map of dredged material island I-58.

Table 12

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-59

Study Area: I Island Number: 59

Size: 10.1 ha Age: 16 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=3 rel.freq.	herbaceous N=3 abun.	shrub N=0	tree N=30 rel.freq.	tree N=30 abun.
Avicennia germinans				6	I
Baccharis halimifolia				2	U
Batis maritima				2	U
Casuarina equisetifolia				2	U
Eupatorium capillifolium				6	I
Iva frutescens				7	A
Laguncularia racemosa				6	I
Lantana camara				17	A
Paspalum vaginatum	100	VA			
Physalis viscosa				2	U
Phytolacca americana				4	I
Sabal palmetto				20	VA
Schinus terebinthifolius				29	VA

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

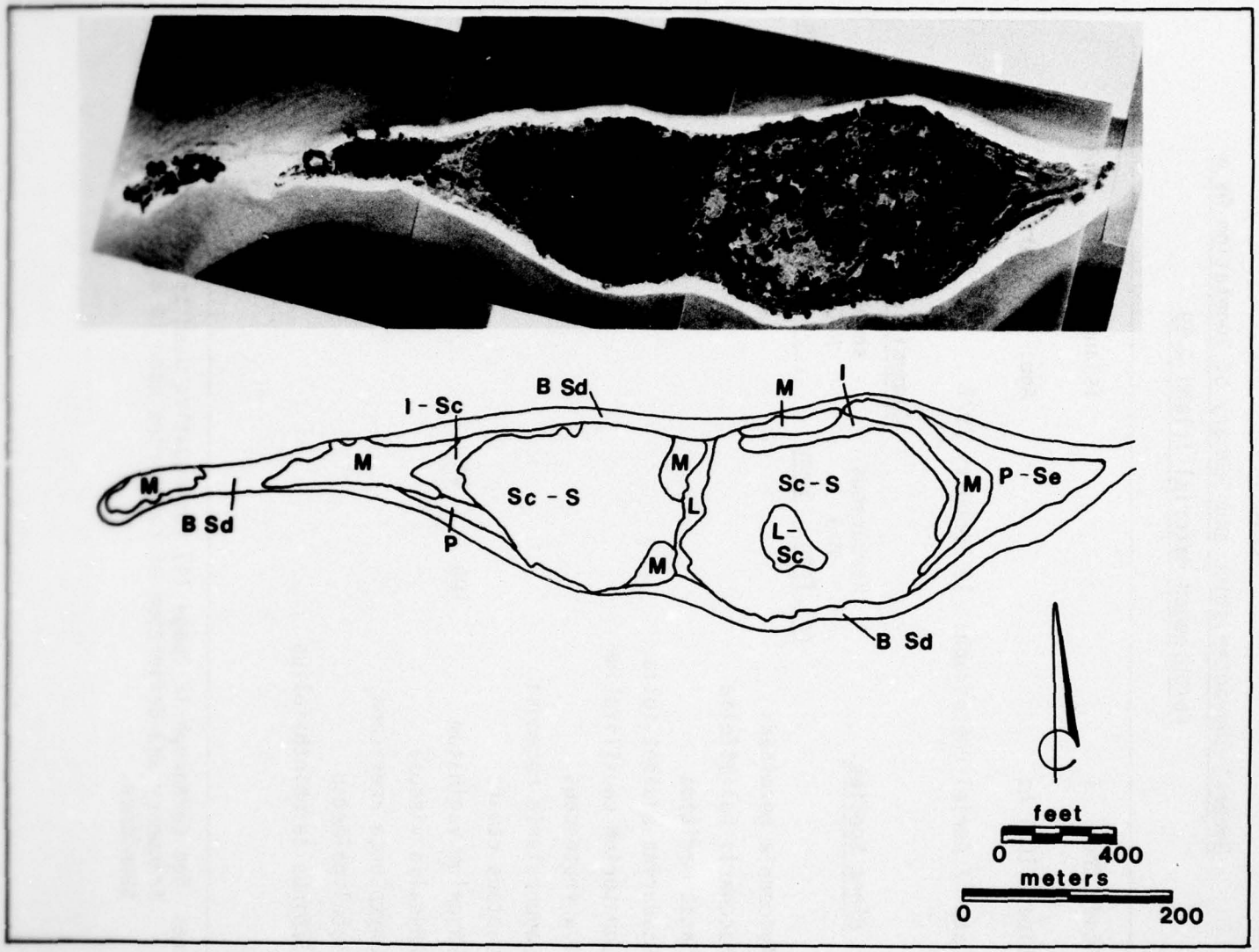

Figure 35. Vertical aerial photograph and vegetation map of dredged material island I-59.

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UNCLASSIFIED WES-D-78-14-VOL-2 NL

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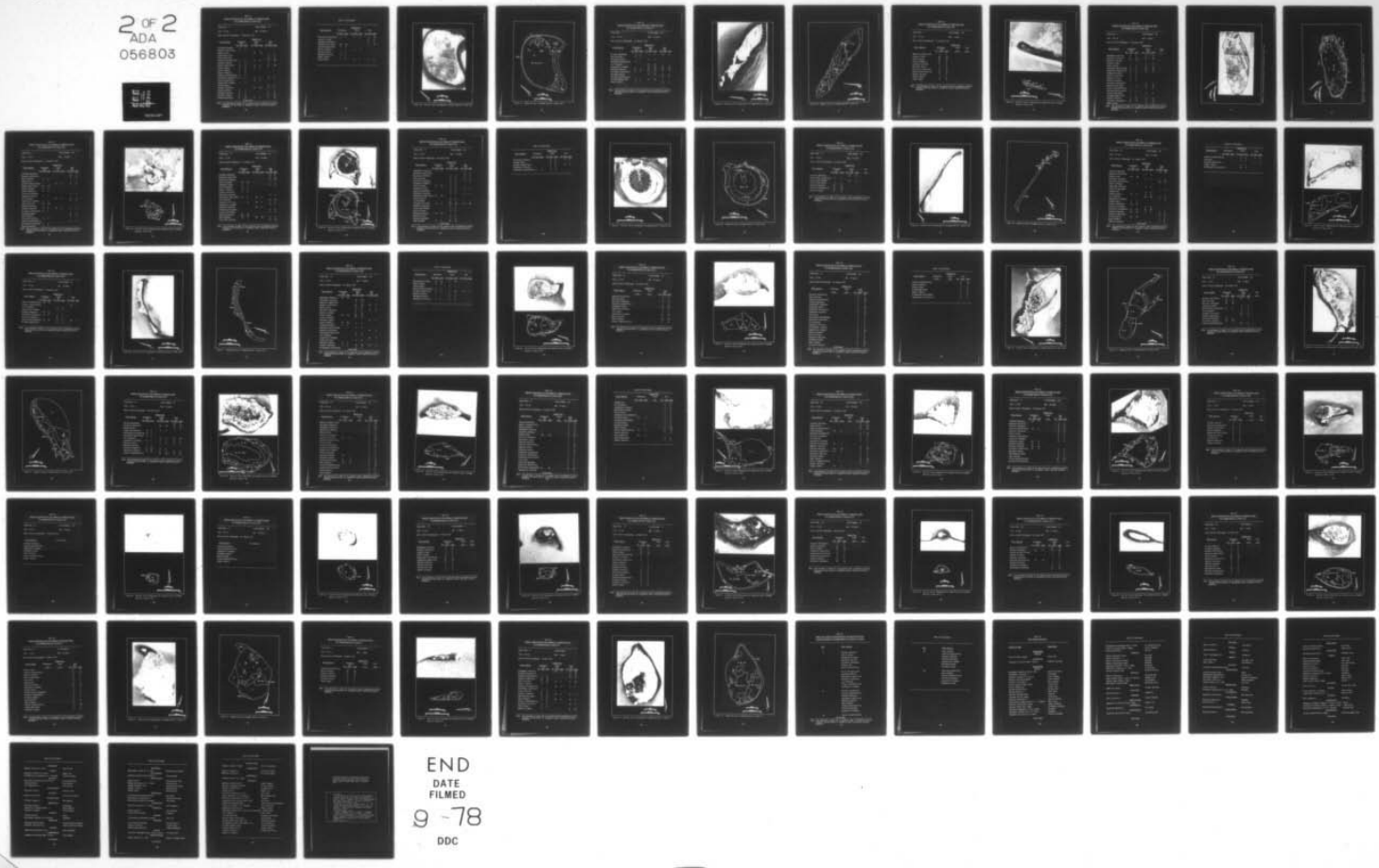

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Table 13

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-60

Study Area: I | Island Number: 60

Size: 6.8 ha | Age: 20 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=77 rel.freq.	abun.	shrub N=2 rel.freq.	abun.	tree N=5 rel.freq.	abun.
Avicennia germinans	1	U				
Baccharis halimifolia	3	I				
Bidens pilosa			15	VA		
Caesalpinia crista					4	A
Cakile fusiformis					4	A
Casuarina equisetifolia	1	U	8	U	19	VA
Cenchrus incertus	1	U				
Cenchrus pauciflorus	6	A	8	U	11	VA
Chloris glauca	6	A	8	U		
Chloris petraea	1	U				
Conyza canadensis	1	U				
Dalbergia ecastophyllum	2	I				
Heterotheca subaxillaris	6	A	8	U	4	A
Lactuca graminifolia			8	U		
Laguncularia racemosa	1	A				
Lantana camara					4	A
Lepidium virginicum			15	VA	4	A
Lippia nodiflora	5	I				
Oenothera humifusa	6	A			11	VA
Paspalum setaceum	2	I			11	VA
Paspalum vaginatum	20	VA	8	U	7	VA

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 13 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Philoxerus vermicularis	3	I	8	U	7	VA
Physalis viscosa					4	A
Phytolacca americana					4	A
Rhynchelytrum repens	29	VA			4	VA
Solidago sempervirens	2	I				
Sonchus oleraceus			8	U		
Spartina patens	1	U				
Sporobolus poiretii	2	I				
Suaeda linearis	1	U				
Vigna luteola	2	I	8	U	4	A

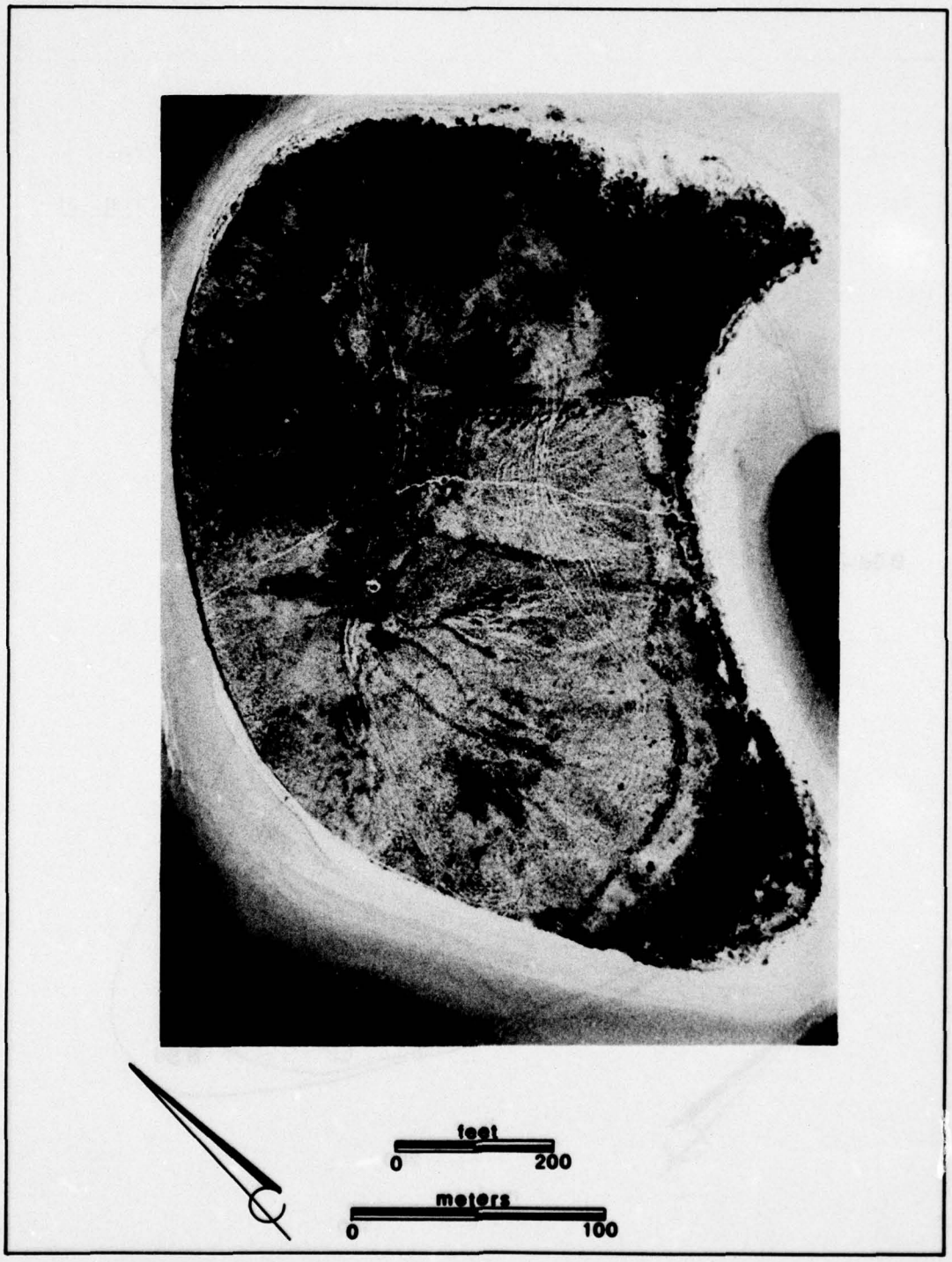

Figure 36. Vertical aerial photograph of dredged material island I-60.

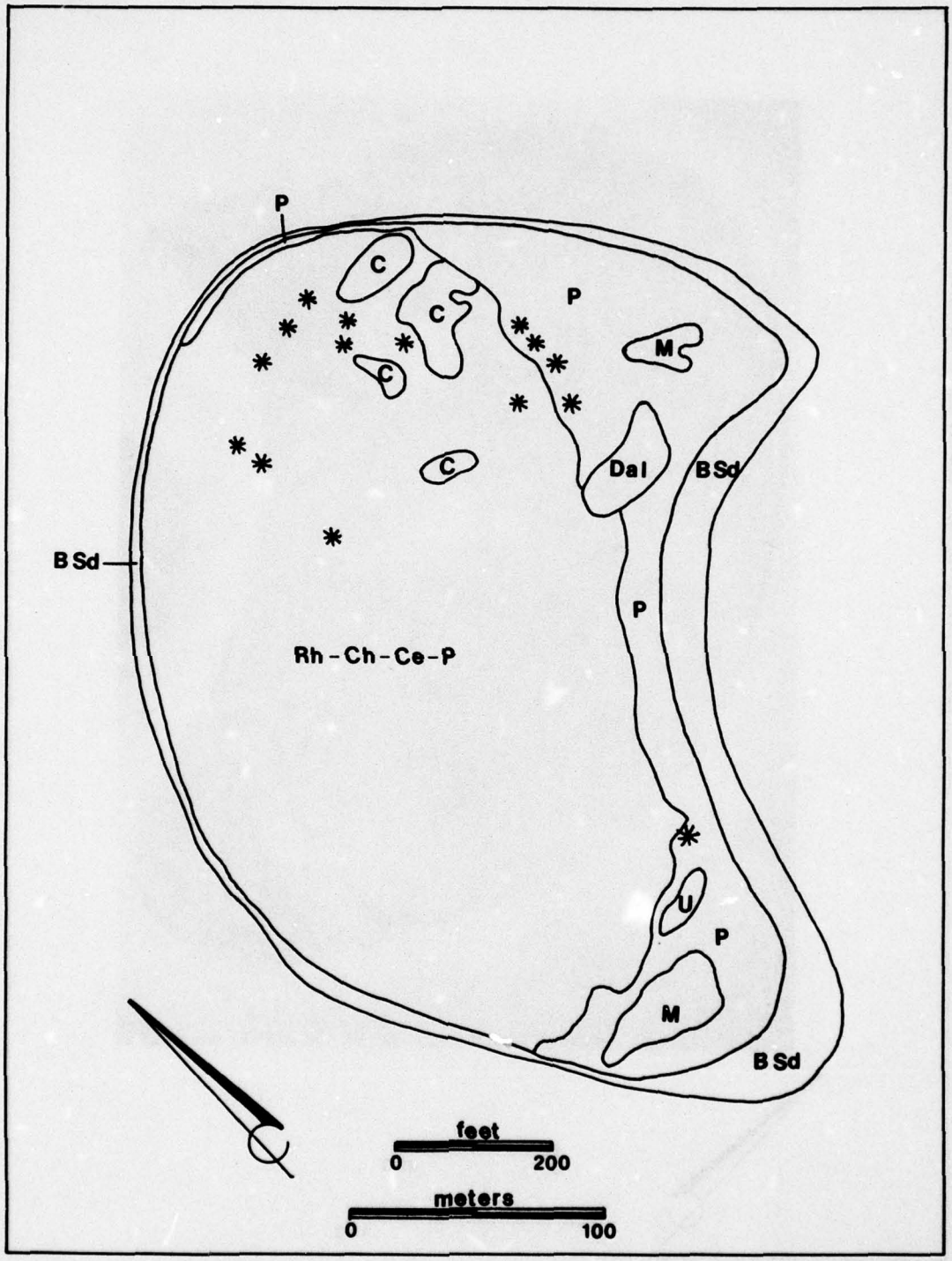

Figure 37. Vegetation map of dredged material island I-60.

Table 14

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-61

Study Area: I | Island Number: 61

Size: 2.3 ha | Age: 12 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=31 rel.freq.	herbaceous N=31 abun.	shrub N=4 rel.freq.	shrub N=4 abun.	tree N=2 rel.freq.	tree N=2 abun.
Avicennia germinans	2	U	7	U	22	A
Batis maritima	8	I				
Conocarpus erecta			7	U		
Dalbergia ecastophyllum	5	I				
Iva frutescens			13	VA		
Laguncularia racemosa			13	VA	22	VA
Paspalum vaginatum	72	VA	27	VA	22	VA
Philoxerus vermicularis	5	I	7	U		
Rhizophora mangle			13	VA	11	U
Sesuvium portulacastrum					11	U
Solidago sempervirens	2	U	13	VA		
Suaeda linearis	5	I			11	U

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Figure 38. Vertical aerial photograph of dredged material island I-61.

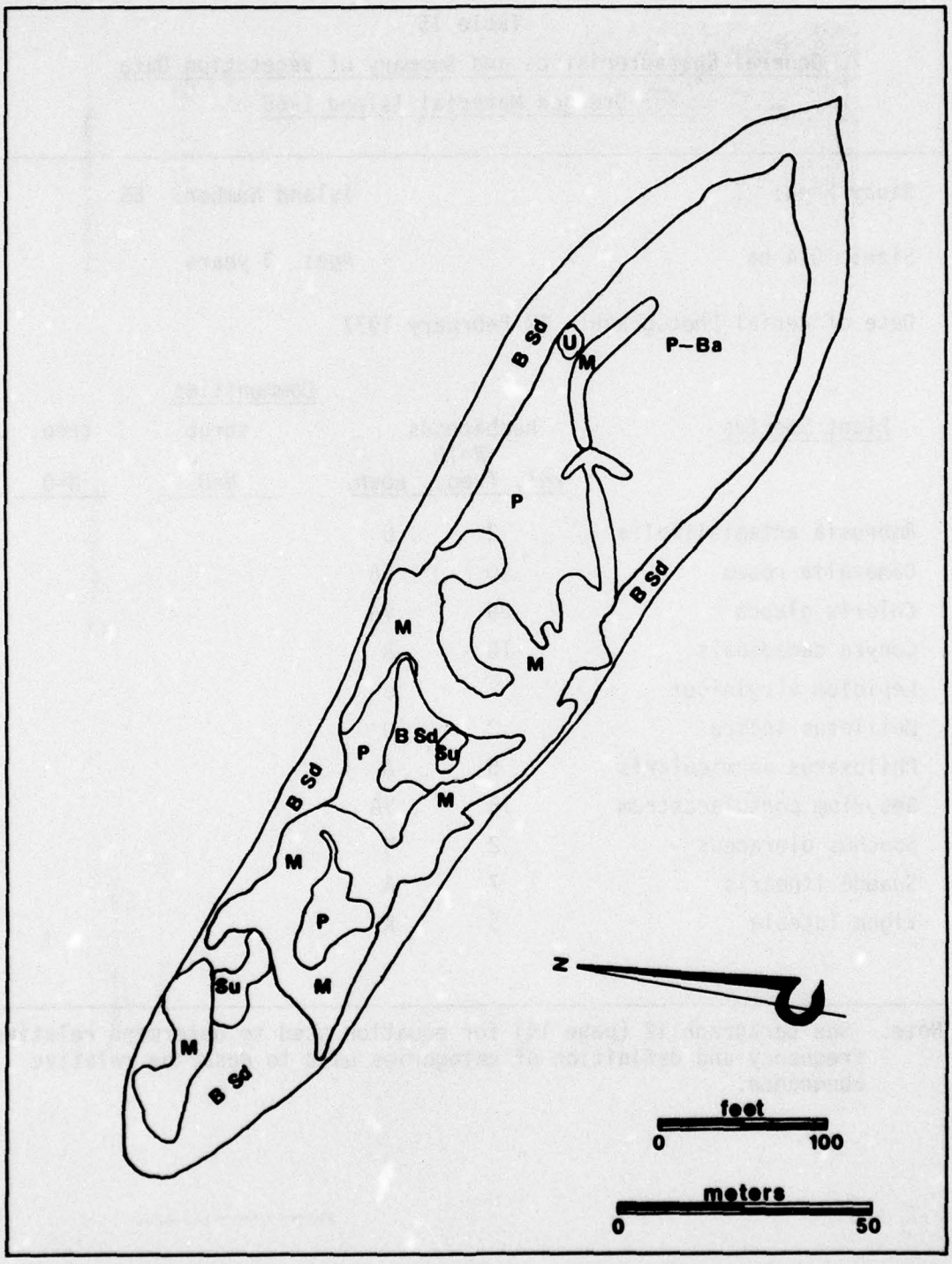

Figure 39. Vegetation map of dredged material island I-61.

Table 15

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-65

Study Area: I | Island Number: 65

Size: 0.4 ha | Age: 3 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=16 rel. freq.	herbaceous N=16 abun.	shrub N=0	tree N=0
Ambrosia artemisiifolia	2	U		
Canavalia rosea	20	VA		
Chloris glauca	29	VA		
Conyza canadensis	10	A		
Lepidium virginicum	2	U		
Melilotus indica	2	U		
Philoxerus vermicularis	5	A		
Sesuvium portulacastrum	15	VA		
Sonchus oleraceus	2	U		
Suaeda linearis	7	A		
Vigna luteola	5	A		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

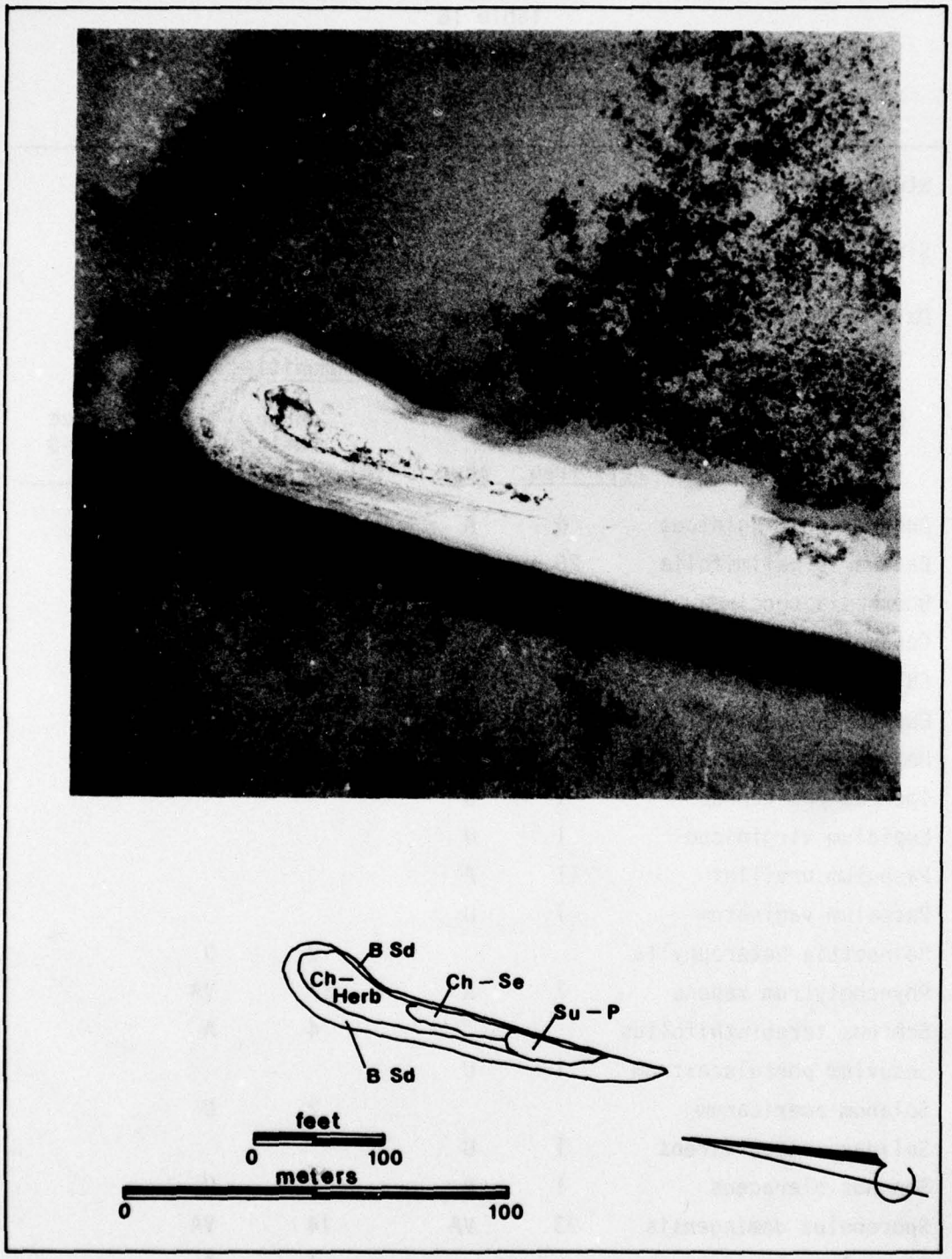

Figure 40. Vertical aerial photograph and vegetation map of dredged material island I-65.

Table 16

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-66

Study Area: I | Island Number: 66

Size: 24.7 ha | Age: 8 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=32 rel. freq.	herbaceous N=32 abun.	shrub N=14 rel. freq.	shrub N=14 abun.	tree N=0
Andropogon virginicus	6	A	6	A	
Baccharis halimifolia	20	VA	19	VA	
Boerhavia coccinea	1	U			
Canavalia rosea			4	A	
Chloris glauca	1	U	6	A	
Eupatorium capillifolium	3	I	10	VA	
Heterotheca subaxillaris	9	A	12	VA	
Ipomoea pes-caprae	1	U			
Lepidium virginicum	1	U			
Paspalum urvillei	11	A			
Paspalum vaginatum	1	U			
Poinsettia heterophylla			2	U	
Rhynchelytrum repens	7	A	17	VA	
Schinus terebinthifolius			4	A	
Sesuvium portulacastrum	1	U			
Solanum americanum			2	U	
Solidago sempervirens	1	U			
Sonchus oleraceus	1	U	2	U	
Sporobolus domingensis	33	VA	14	VA	
Vigna luteola			4	A	

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

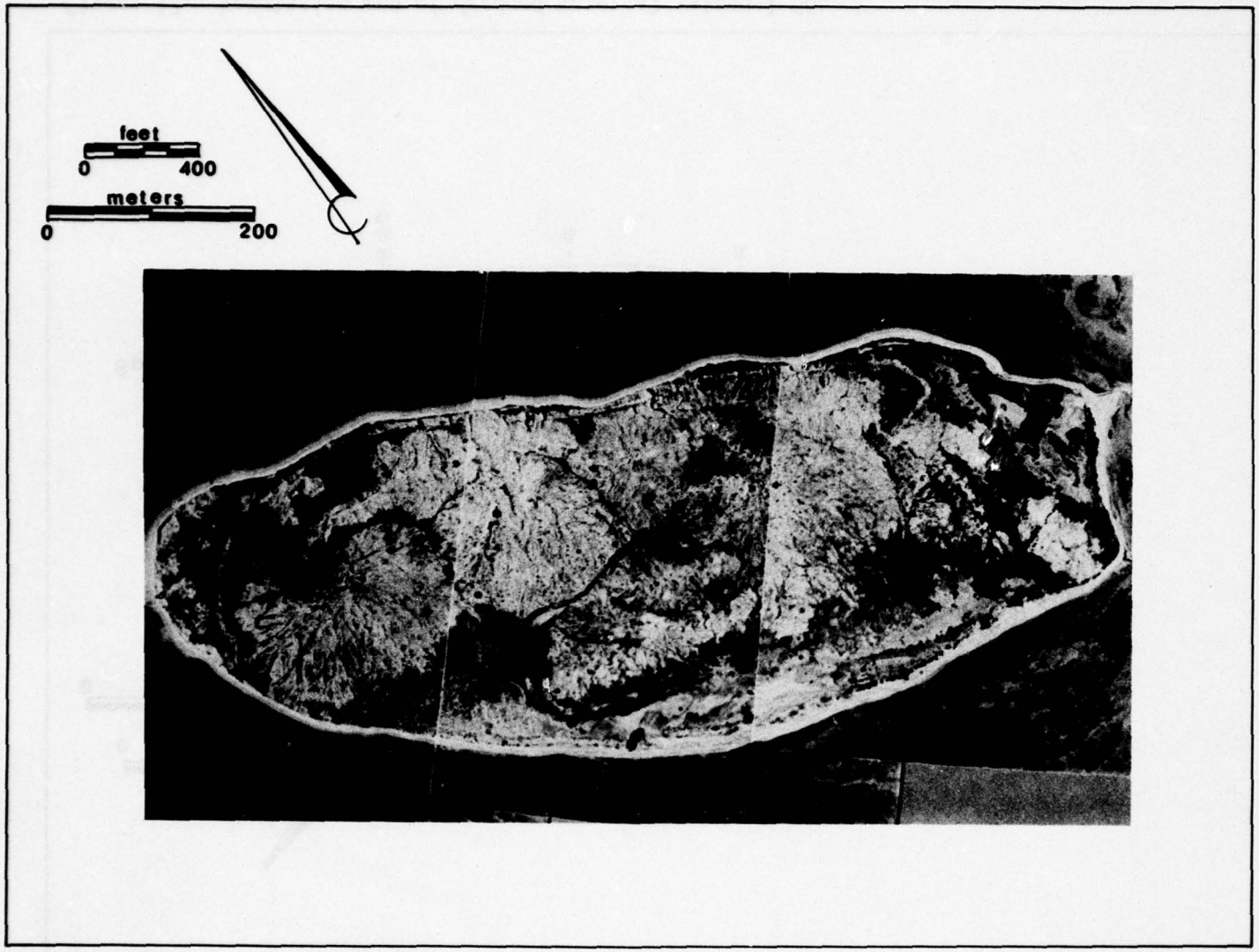

Figure 41. Vertical aerial photograph of dredged material island I-66.

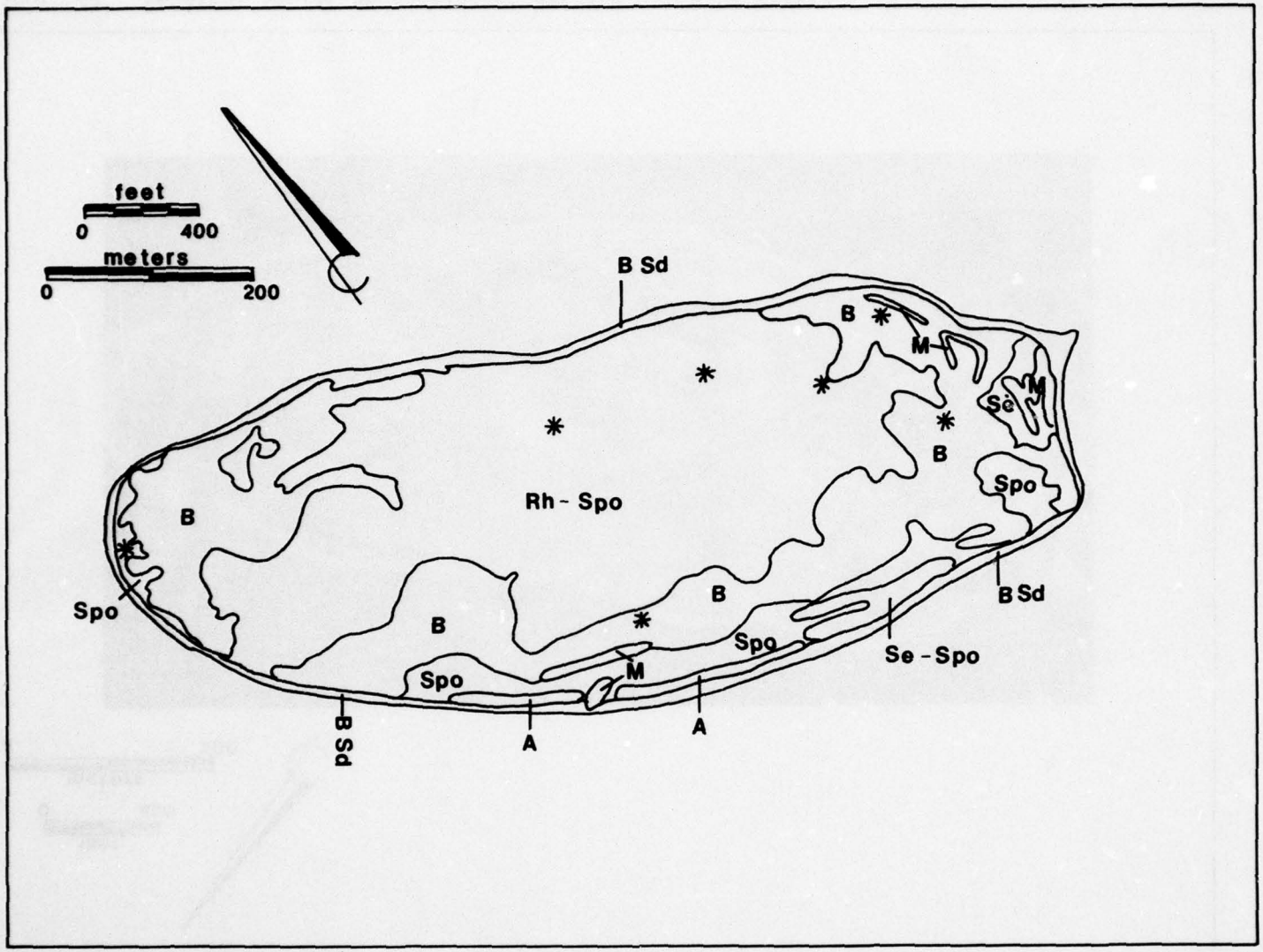

Figure 42. Vegetation map of dredged material island I-66.

Table 17

General Characteristics and Summary of Vegetation Data

For Dredged Material Island I-68

Study Area: I | Island Number: 68

Size: 1.4 ha | Age: 15 years

Date of Aerial Photograph: 12 February 1977

Plant Species	Communities: herbaceous N=28 rel.freq.	herbaceous N=28 abun.	shrub N=1 rel.freq.	shrub N=1 abun.	tree N=2 rel.freq.	tree N=2 abun.
Avicennia germinans					9	U
Baccharis halimifolia					9	U
Batis maritima	5	A			9	U
Bidens pilosa	3	I				
Casuarina equisetifolia			33	U	9	U
Cenchrus pauciflorus	29	VA				
Chloris petraea	2	U				
Conyza canadensis	6	A				
Forestiera segregata					9	U
Ipomoea pes-caprae	5	A				
Iva frutescens			33	U	9	U
Laguncularia racemosa	3	I			9	U
Lippia nodiflora	25	VA				
Oenothera humifusa	3	I				
Paspalum vaginatum	5	A	33	U	9	U
Philoxerus vermicularis	3	I				
Rhizophora mangle					9	U
Sabal palmetto					9	U
Salicornia virginica	2	U				
Schinus terebinthifolius					9	U
Sesuvium portulacastrum	5	A				
Uniola paniculata	3	I				

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

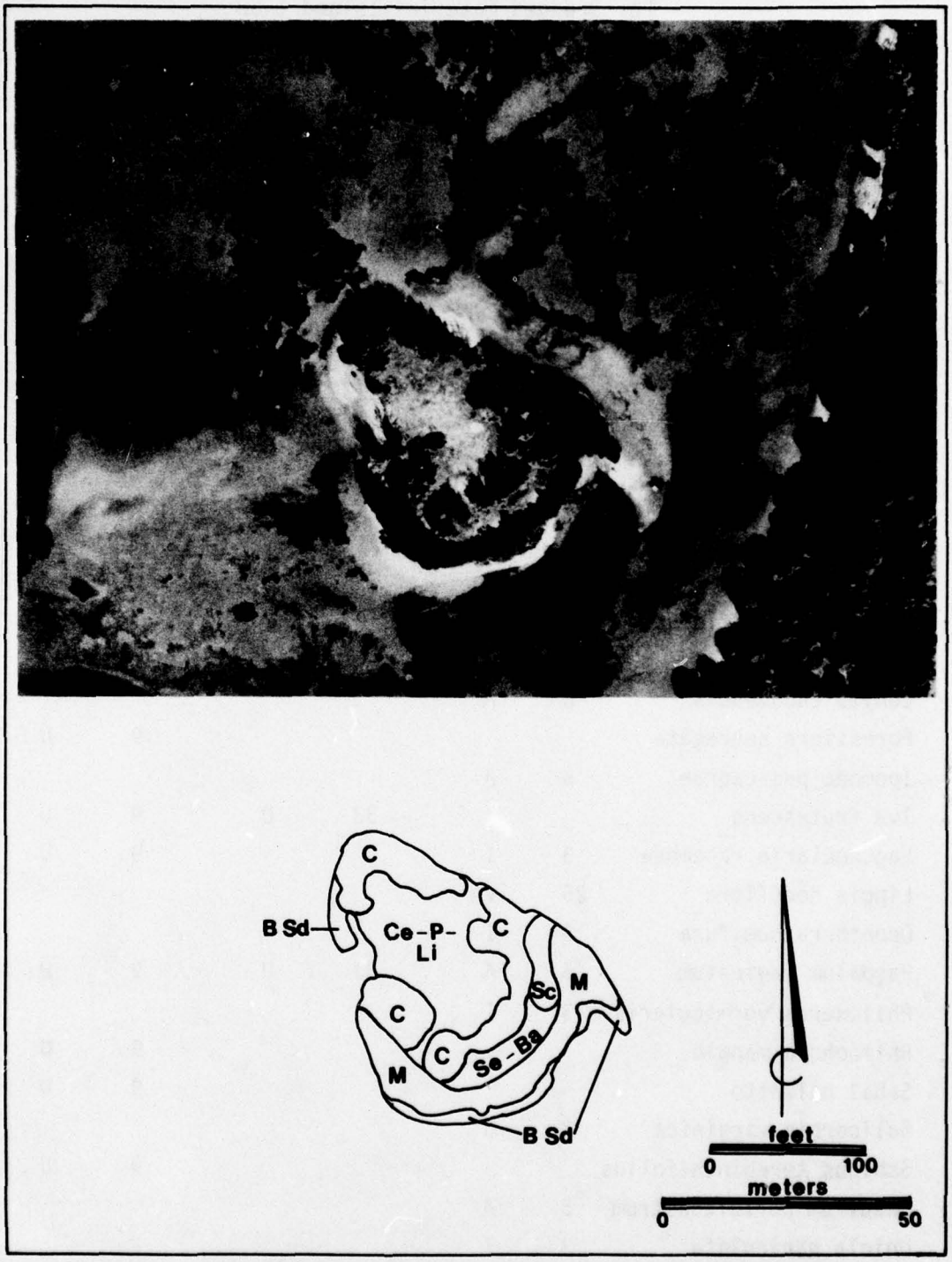

Figure 43. Vertical aerial photograph and vegetation map of dredged material island I-68.

Table 18

General Characteristics and Summary of Vegetation Data
For Dredged Material Island II-12

Study Area: II | Island Number: 12

Size: 1.2 ha | Age: 25 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=20 rel.freq.	herbaceous N=20 abun.	shrub N=2 rel.freq.	shrub N=2 abun.	tree N=3 rel.freq.	tree N=3 abun.
Avicennia germinans					6	U
Baccharis halimifolia					6	U
Borrichia frutescens					13	VA
Chloris petraea	29	VA				
Conocarpus erecta					6	U
Conyza canadensis	10	A				
Cyperus ligularis	3	U				
Cyperus planifolius	7	A				
Eupatorium serotinum					6	U
Heterotheca subaxillaris	16	A	20	U		
Iva frutescens					19	VA
Juniperus silicicola	7	A	20	U	6	U
Laguncularia racemosa					6	U
Lepidium virginicum			20	U		
Limonium carolinianum					6	U
Lycium carolinianum					6	U
Oenothera humifusa	20	VA				
Sabal palmetto	10	A	40	VA	6	U
Salicornia virginica					13	VA

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

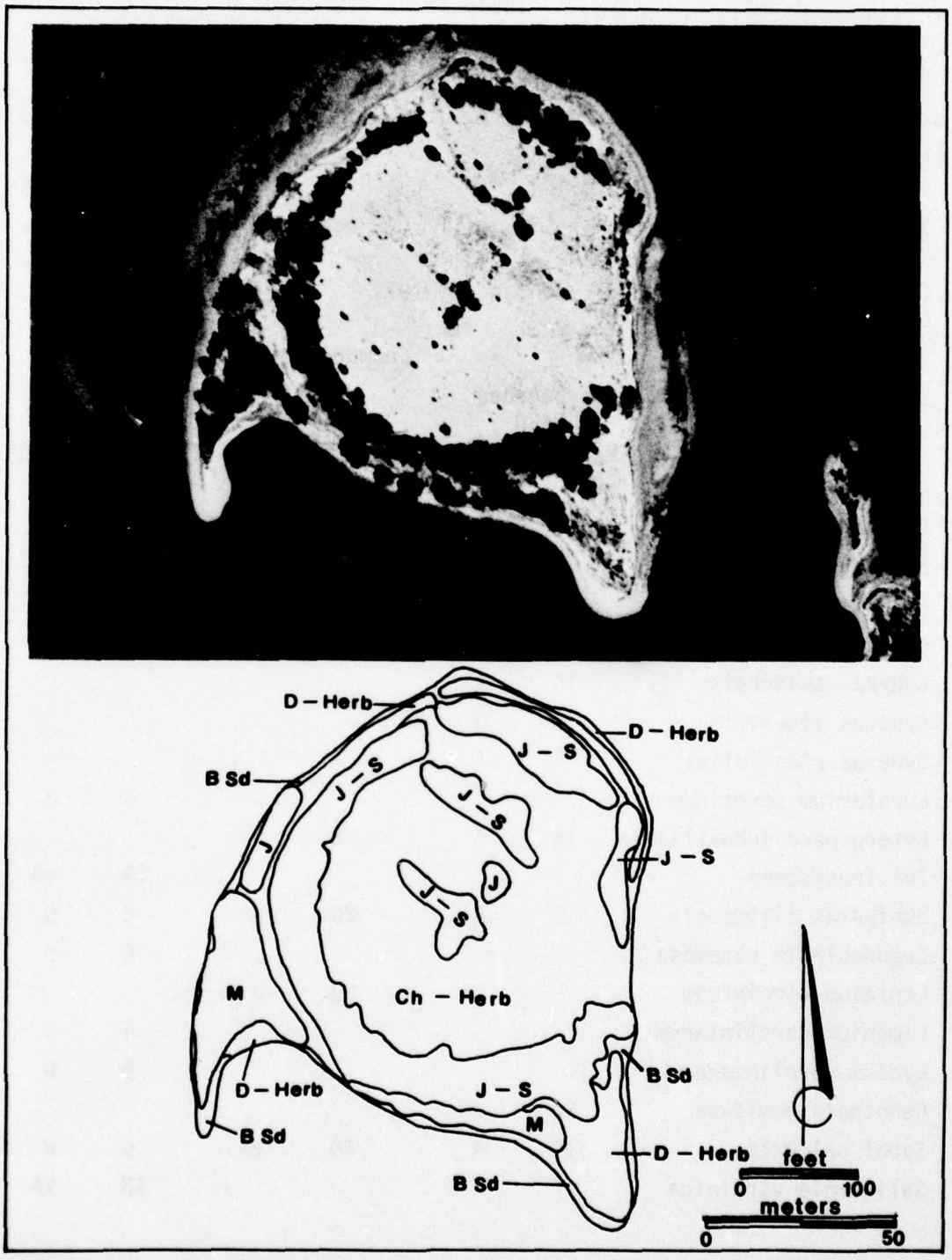

Figure 44. Vertical aerial photograph and vegetation map of dredged material island II-12.

Table 19

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-26

Study Area: II | Island Number: 26

Size: 2.2 ha | Age: 25 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=16 rel.freq.	herbaceous N=16 abun.	shrub N=16 rel.freq.	shrub N=16 abun.	tree N=4 rel.freq.	tree N=4 abun.
Andropogon virginicus	4	U				
Baccharis angustifolia					9	U
Baccharis halimifolia			4	A	9	U
Batis maritima			2	U	9	U
Borrichia frutescens			4	A	9	U
Chamaesyce blodgettii			2	U		
Chloris petraea	37	VA	2	U		
Conocarpus erecta			2	U	9	U
Cyperus polystachyos			2	U		
Eupatorium serotinum			2	U	9	U
Heterotheca subaxillaris	22	VA				
Iresine celosia			2	U		
Iva frutescens			2	U		
Juniperus silicicola	4	U	20	VA	27	VA
Lepidium virginicum			4	A		
Lycium carolinianum			2	U		
Myrica cerifera			2	U		
Oenothera humifusa	18	VA				
Opuntia stricta			2	U		
Paspalum vaginatum			2	U		
Sabal palmetto	8	A	24	VA		

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 19 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Salicornia virginica			4	A	9	U
Serenoa repens			4	A		
Solidago sempervirens			2	U	9	U
Sporobolus virginicus			2	U		
Trichostema suffrutescens	8	A	8	A		

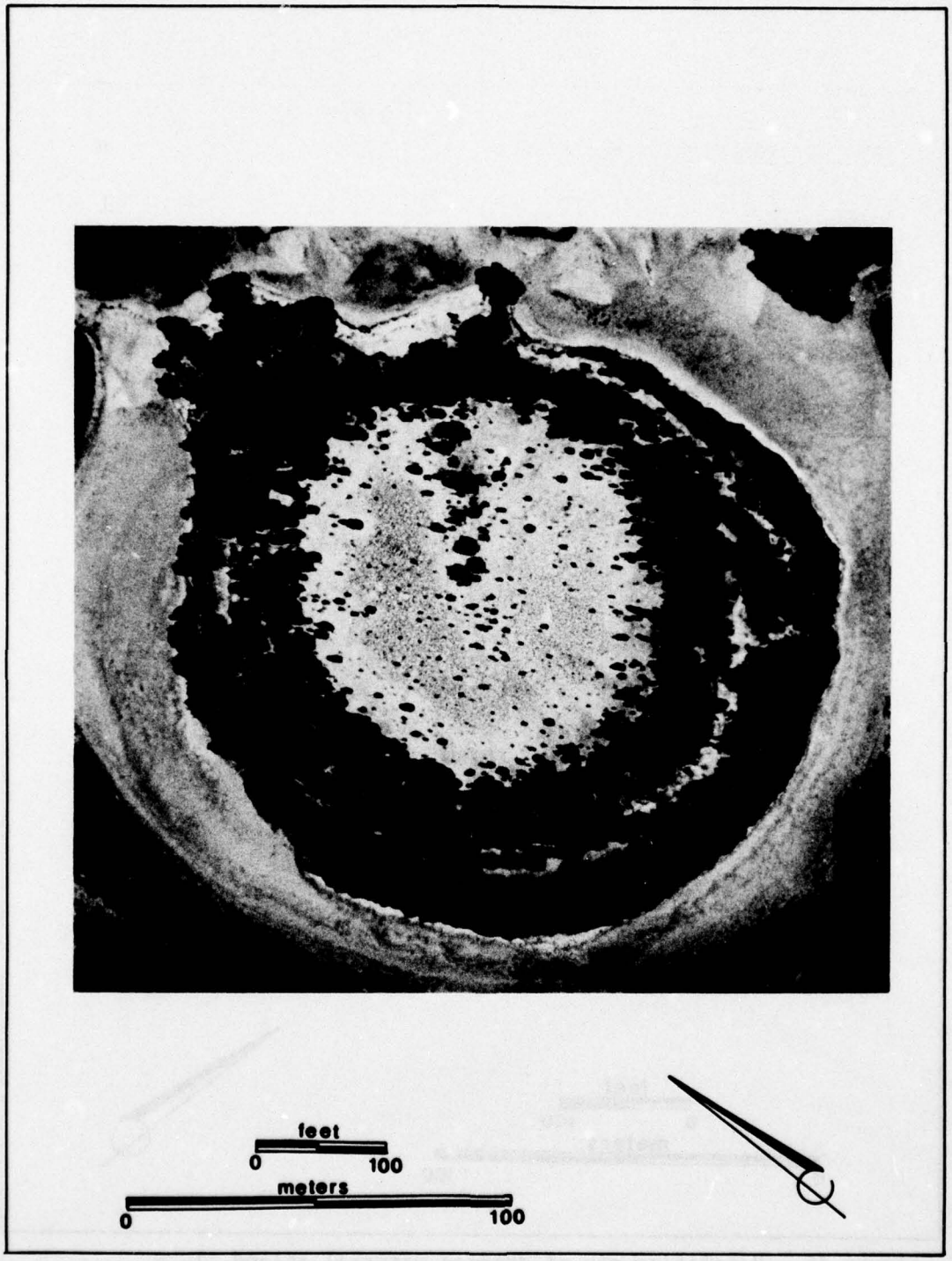

Figure 45. Vertical aerial photograph of dredged material island II-26.

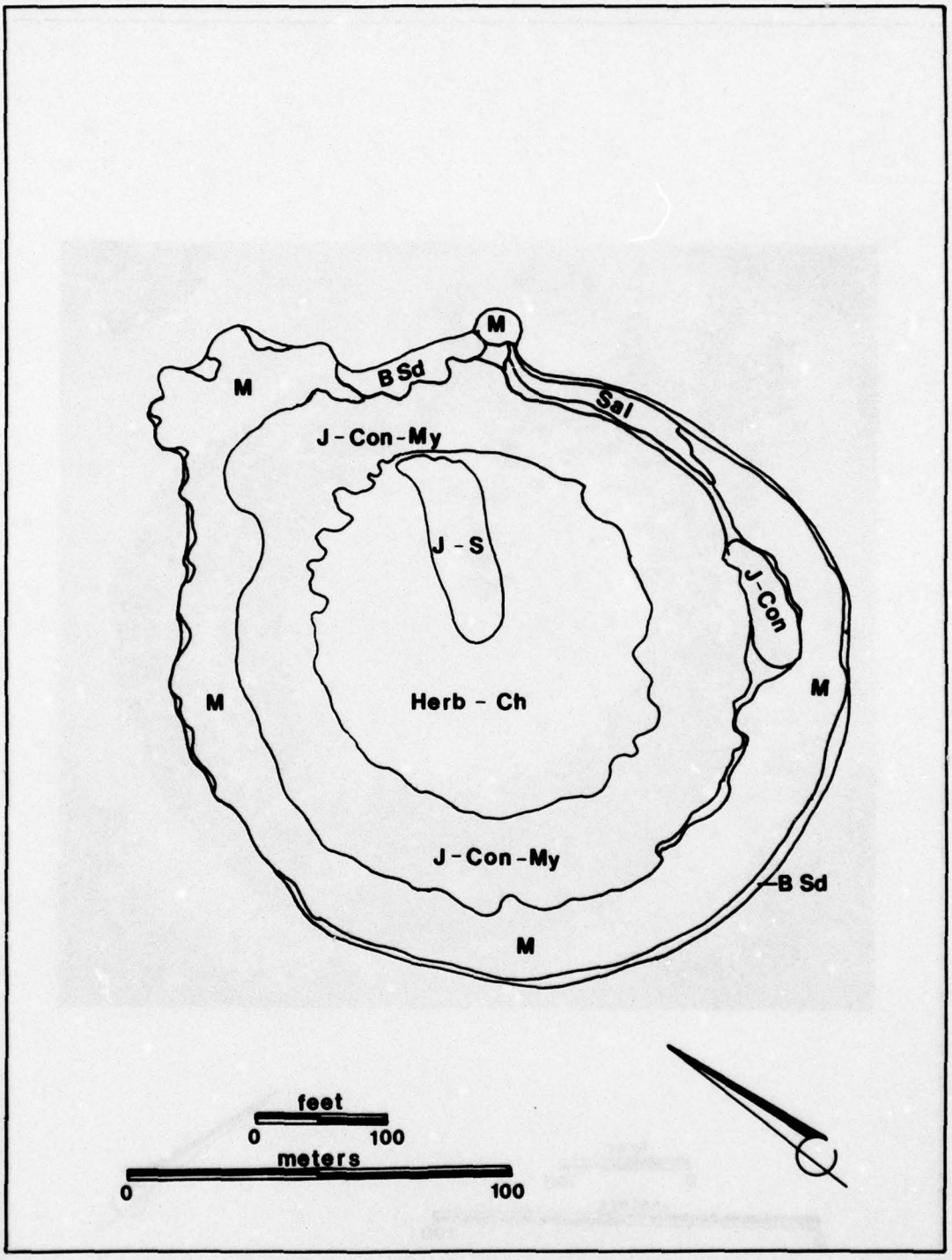

Figure 46. Vegetation map of dredged material island II-26.

Table 20

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-64

Study Area: II | Island Number: 64

Size: 0.9 ha | Age: 15 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=18 rel.freq.	herbaceous N=18 abun.	shrub N=1 rel.freq.	shrub N=1 abun.	tree N=0
Avicennia germinans			50	U	
Heliotropium curassavicum	2	U			
Laguncularia racemosa			50	U	
Lycium carolinianum	9	A			
Paspalum vaginatum	41	VA			
Philoxerus vermicularis	34	VA			
Physalis viscosa	14	VA			

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

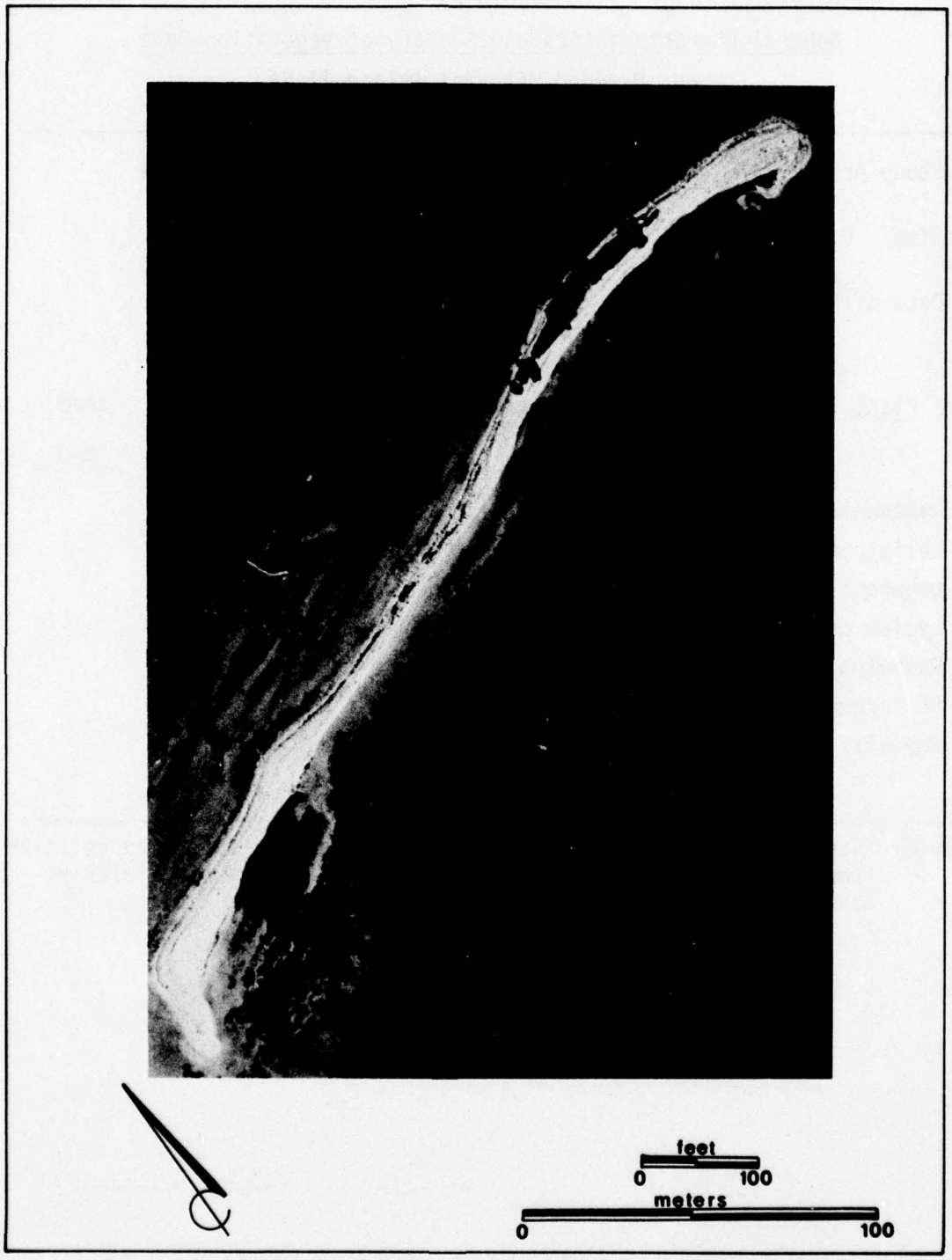

Figure 47. Vertical aerial photograph of dredged material island II-64.

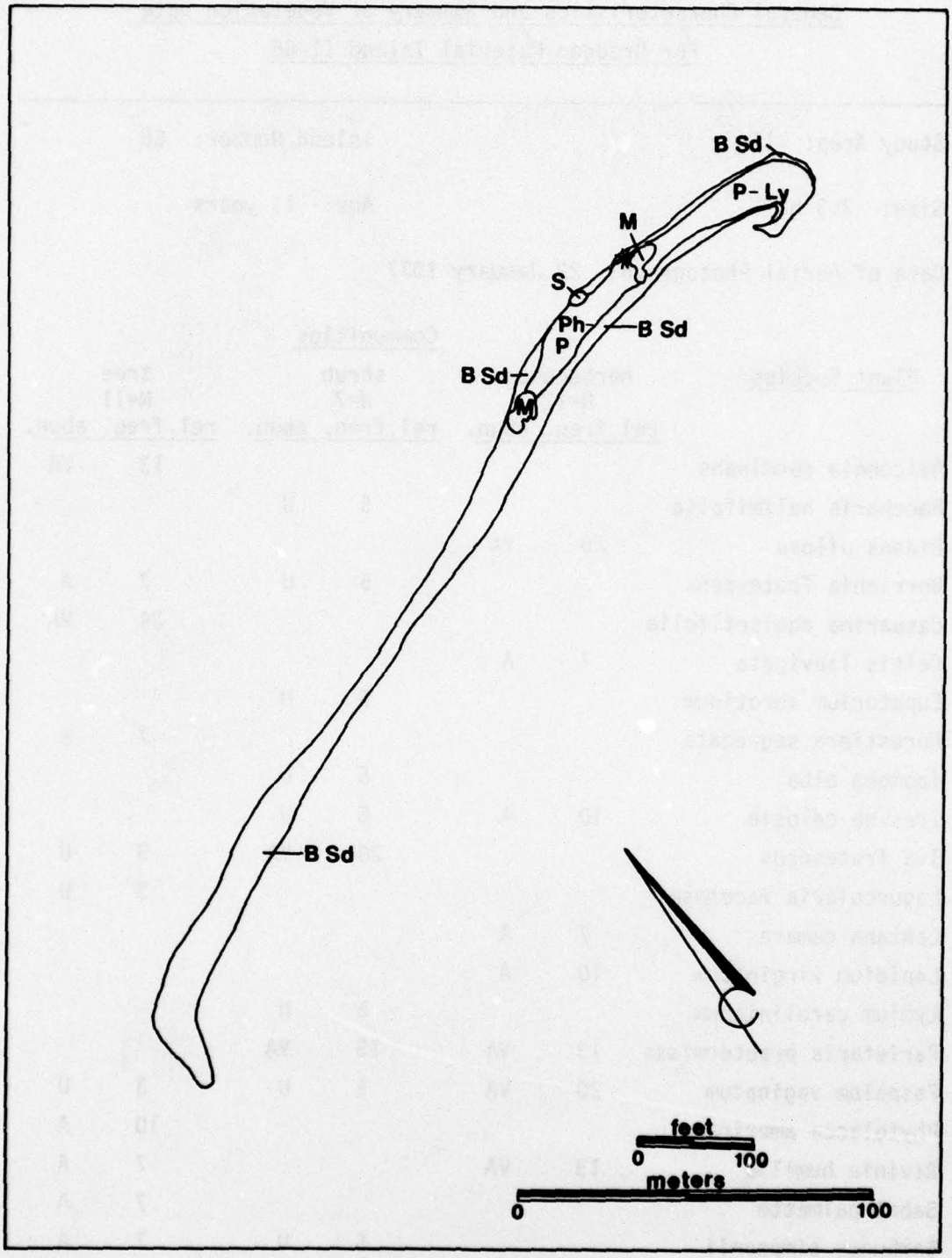

Figure 48. Vegetation map of dredged material island II-64.

Table 21

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-66

Study Area: II | Island Number: 66

Size: 2.3 ha | Age: 15 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=12 rel.freq.	herbaceous N=12 abun.	shrub N=7 rel.freq.	shrub N=7 abun.	tree N=11 rel.freq.	tree N=11 abun.
Avicennia germinans					13	VA
Baccharis halimifolia			5	U		
Bidens pilosa	20	VA				
Borrichia frutescens			5	U	7	A
Casuarina equisetifolia					24	VA
Celtis laevigata	7	A				
Eupatorium serotinum			5	U		
Forestiera segregata					7	A
Ipomoea alba			5	U		
Iresine celosia	10	A	5	U		
Iva frutescens			20	VA	3	U
Laguncularia racemosa					3	U
Lantana camara	7	A				
Lepidium virginicum	10	A				
Lycium carolinianum			5	U		
Parietaria praetermissa	13	VA	15	VA		
Paspalum vaginatum	20	VA	5	U	3	U
Phytolacca americana					10	A
Rivinia humilis	13	VA			7	A
Sabal palmetto					7	A
Sambucus simpsonii			5	U	7	A

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 21 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Schinus terebinthifolius			5	U	3	U
Sida acuta			5	U		
Solidago sempervirens					7	A
Suaeda linearis			5	U		
Zanthoxylum clava-herculis			10	A		

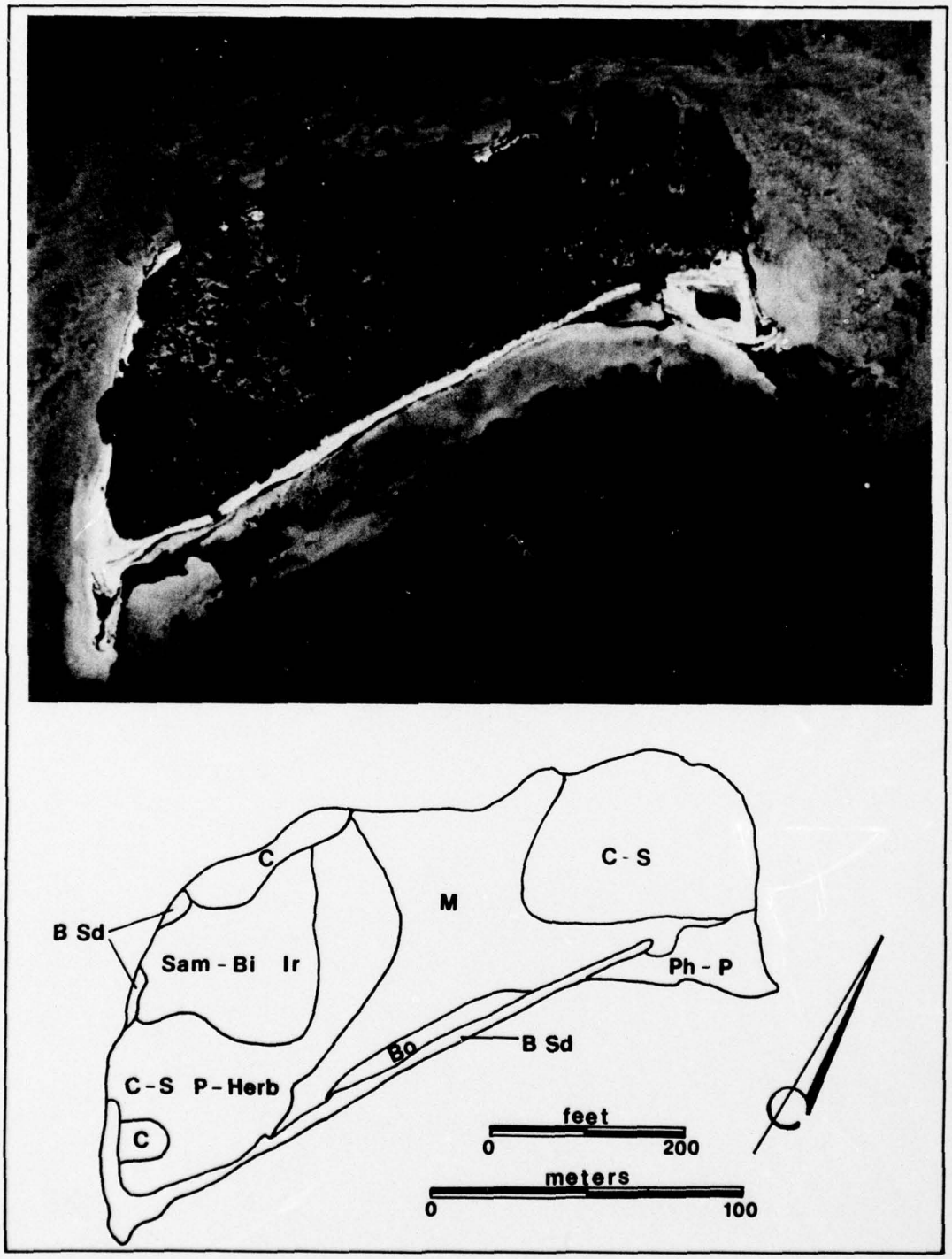

Figure 49. Vertical aerial photograph and vegetation map of dredged material island II-66.

Table 22

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-67

Study Area: II | Island Number: 67

Size: 0.5 ha | Age: 15 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=10 rel.freq.	herbaceous N=10 abun.	shrub N=1 rel.freq.	shrub N=1 abun.	tree N=1 rel.freq.	tree N=1 abun.
Ambrosia artemisiifolia	22	VA				
Casuarina equisetifolia					50	U
Iva frutescens			17	U		
Laguncularia racemosa			17	U		
Paspalum vaginatum	39	VA				
Philoxerus vermicularis	4	U	17	U		
Salicornia virginica			17	U		
Sesuvium portulacastrum	35	VA	17	U	50	U
Solidago sempervirens			17	U		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

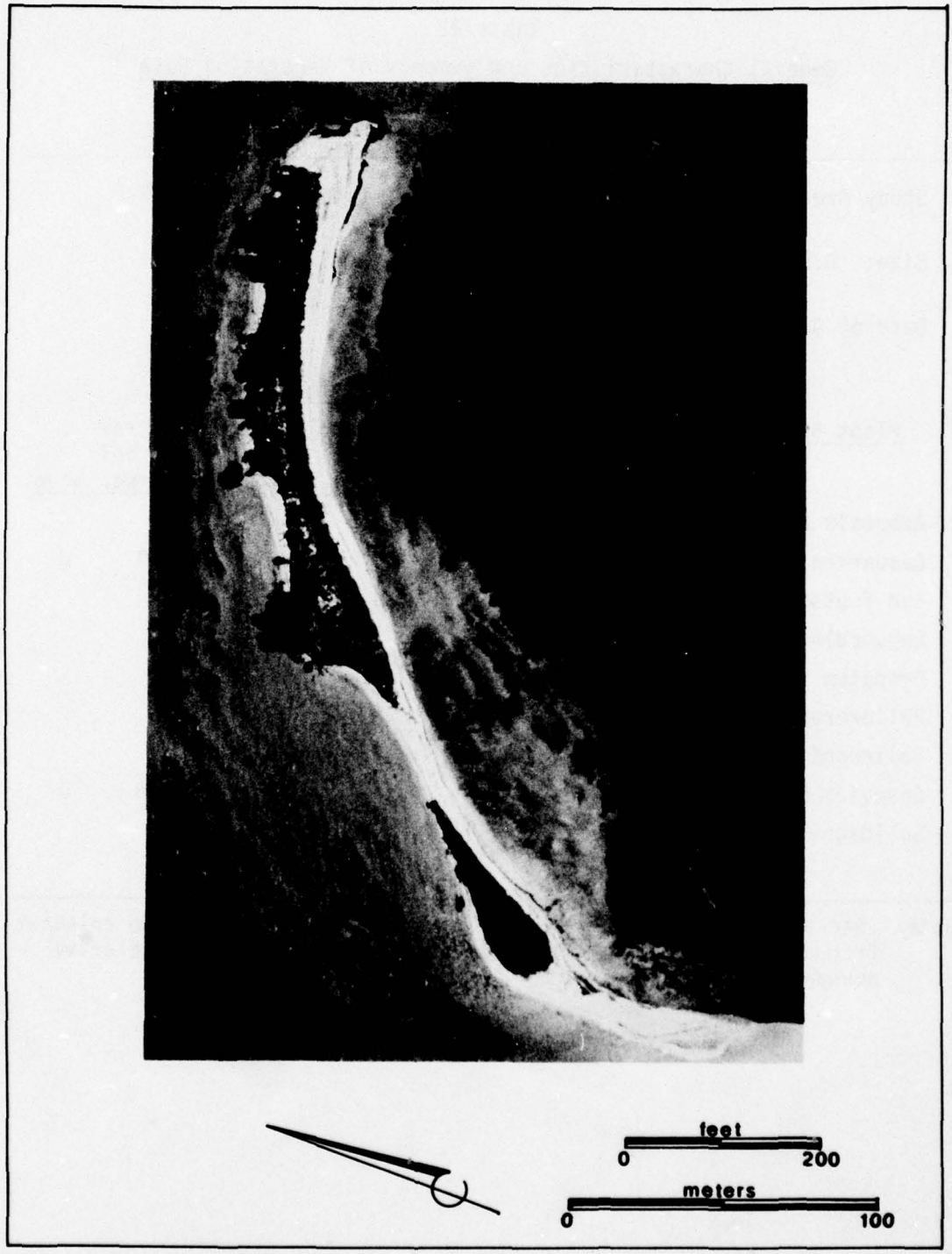

Figure 50. Vertical aerial photograph of dredged material island II-67.

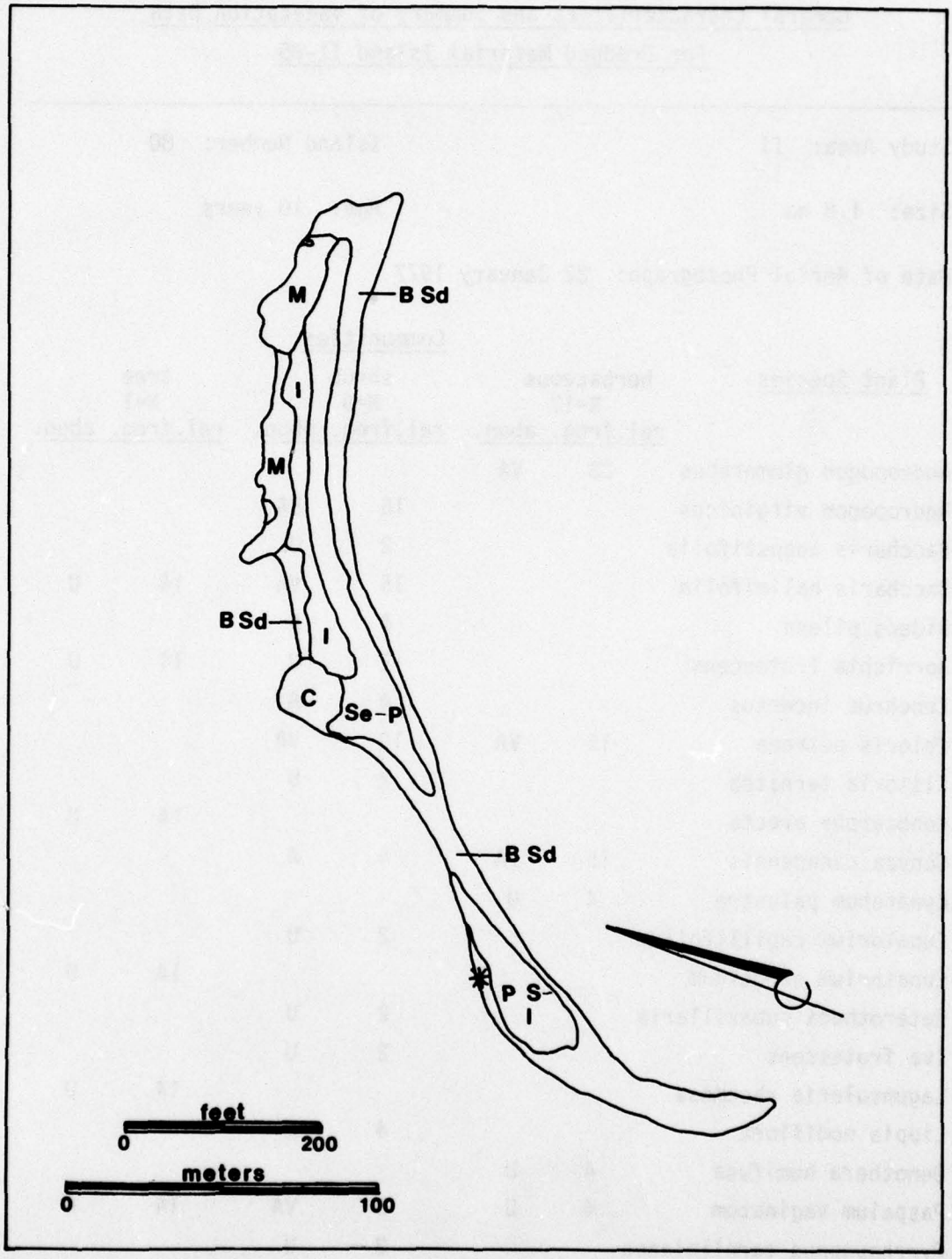

Figure 51. Vegetation map of dredged material island II-67.

Table 23

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-80

Study Area: II | Island Number: 80

Size: 1.8 ha | Age: 10 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=12 rel.freq.	herbaceous N=12 abun.	shrub N=9 rel.freq.	shrub N=9 abun.	tree N=1 rel.freq.	tree N=1 abun.
Andropogon glomeratus	23	VA				
Andropogon virginicus			15	VA		
Baccharis angustifolia			2	U		
Baccharis halimifolia			15	VA	14	U
Bidens pilosa			4	A		
Borrichia frutescens			2	U	14	U
Cenchrus incertus			4	A		
Chloris petraea	15	VA	10	VA		
Clitoria ternatea			2	U		
Conocarpus erecta					14	U
Conyza canadensis	15	VA	4	A		
Cynanchum palustre	4	U				
Eupatorium capillifolium			2	U		
Eupatorium serotinum					14	U
Heterotheca subaxillaris			2	U		
Iva frutescens			2	U		
Laguncularia racemosa					14	U
Lippia nodiflora			4	A		
Oenothera humifusa	4	U				
Paspalum vaginatum	4	U	8	VA	14	U
Pyrrhopappus carolinianus			2	U		

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 23 (Concluded)

Plant Species	Communities					
	herbaceous		shrub		tree	
	rel.freq.	abun.	rel.freq.	abun.	rel.freq.	abun.
Rhynchelytrum repens	15	VA	6	VA		
Sabal palmetto	8	A				
Serenoa repens			2	U		
Sesuvium portulacastrum	4	U				
Solidago sempervirens	4	U	8	VA	14	U
Sonchus oleraceus			4	A		
Sporobolus poiretii			2	U		
Sporobolus virginicus	4	U	4	A		

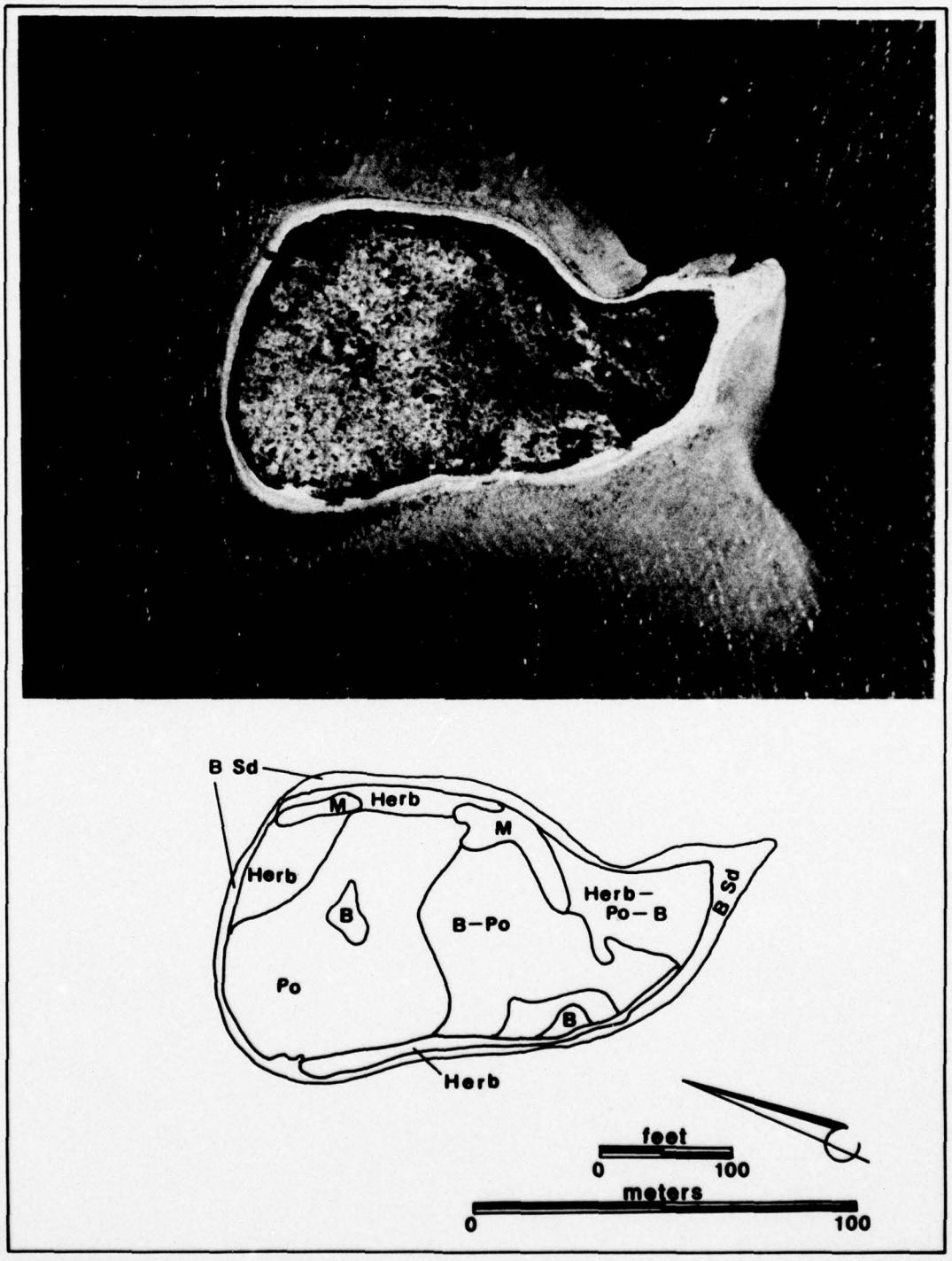

Figure 52. Vertical aerial photograph and vegetation map of dredged material island II-80.

Table 24

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-87

Study Area: II | Island Number: 87

Size: 1.4 ha | Age: 40 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=0	shrub N=0	tree N=15 rel. freq.	tree N=15 abun.
Baccharis halimifolia			3	U
Batis maritima			3	U
Borrichia frutescens			3	U
Casuarina equisetifolia			3	U
Conocarpus erecta			21	VA
Eupatorium serotinum			3	U
Ficus aurea			3	U
Laguncularia racemosa			21	VA
Myrica cerifera			3	U
Sabal palmetto			28	VA
Schinus terebinthifolius			7	A

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

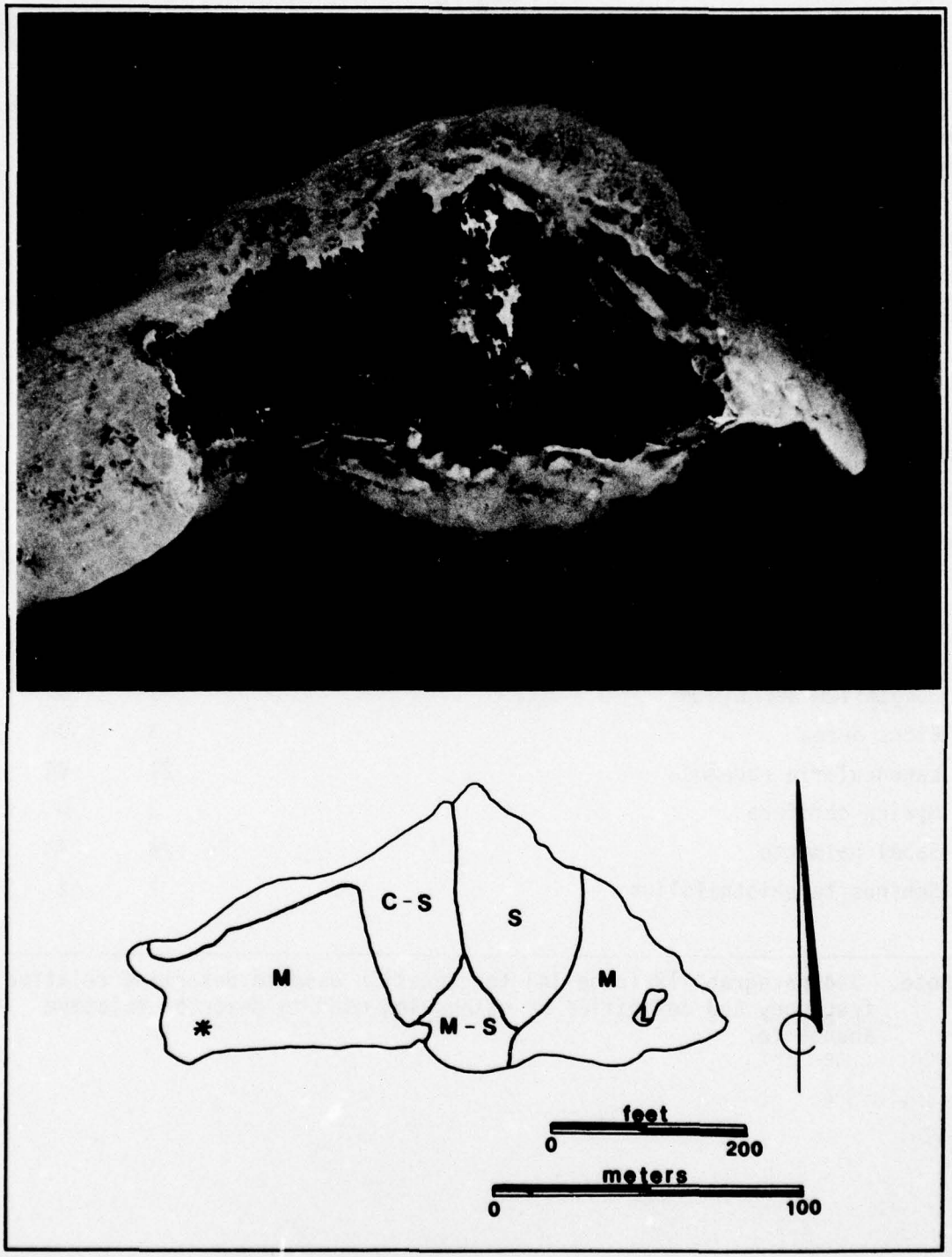

Figure 53. Vertical aerial photograph and vegetation map of dredged material island II-87.

Table 25

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-88

Study Area: II | Island Number: 88

Size: 2.4 ha | Age: 40 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=0	shrub N=0	tree N=15 rel. freq.	tree N=15 abun.
Baccharis halimifolia			4	A
Batis maritima			4	A
Casuarina equisetifolia			11	VA
Cladium jamaicense			1	U
Cnidosculus stimulosus			1	U
Conocarpus erecta			6	VA
Erechtites hieracifolia			4	A
Eupatorium serotinum			7	VA
Ficus aurea			5	U
Heliotropium angiospermum			1	U
Hydrocotyle bonariensis			1	U
Iva frutescens			1	U
Juniperus silicicola			2	A
Kosteletzkya virginica			1	U
Laguncularia racemosa			6	VA
Melothria pendula			4	A
Myrica cerifera			2	A
Phytolacca americana			2	A
Rhizophora mangle			1	U
Sabal palmetto			13	VA
Salicornia bigelovii			1	U

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 25 (Concluded)

Plant Species	Communities herbaceous N=0	shrub N=0	tree rel. freq.	tree abun.
Schinus terebinthifolius			6	VA
Senecio glabellus			4	A
Serenoa repens			1	U
Solanum americanum			1	U
Suaeda linearis			2	A
Trichostema suffrutescens			2	A
Zanthoxylum clava-herculis			4	A

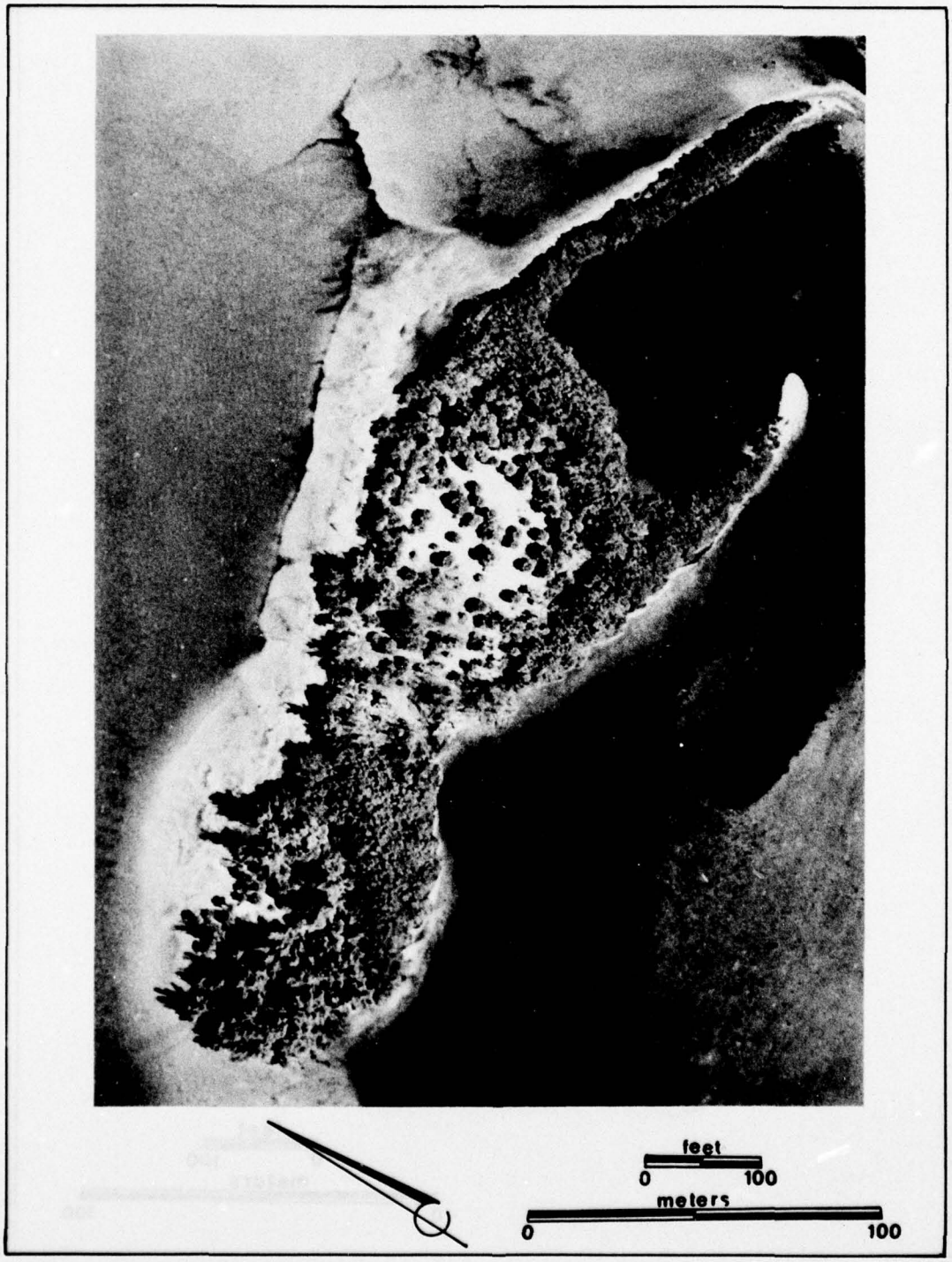

Figure 54. Vertical aerial photograph of dredged material island II-88.

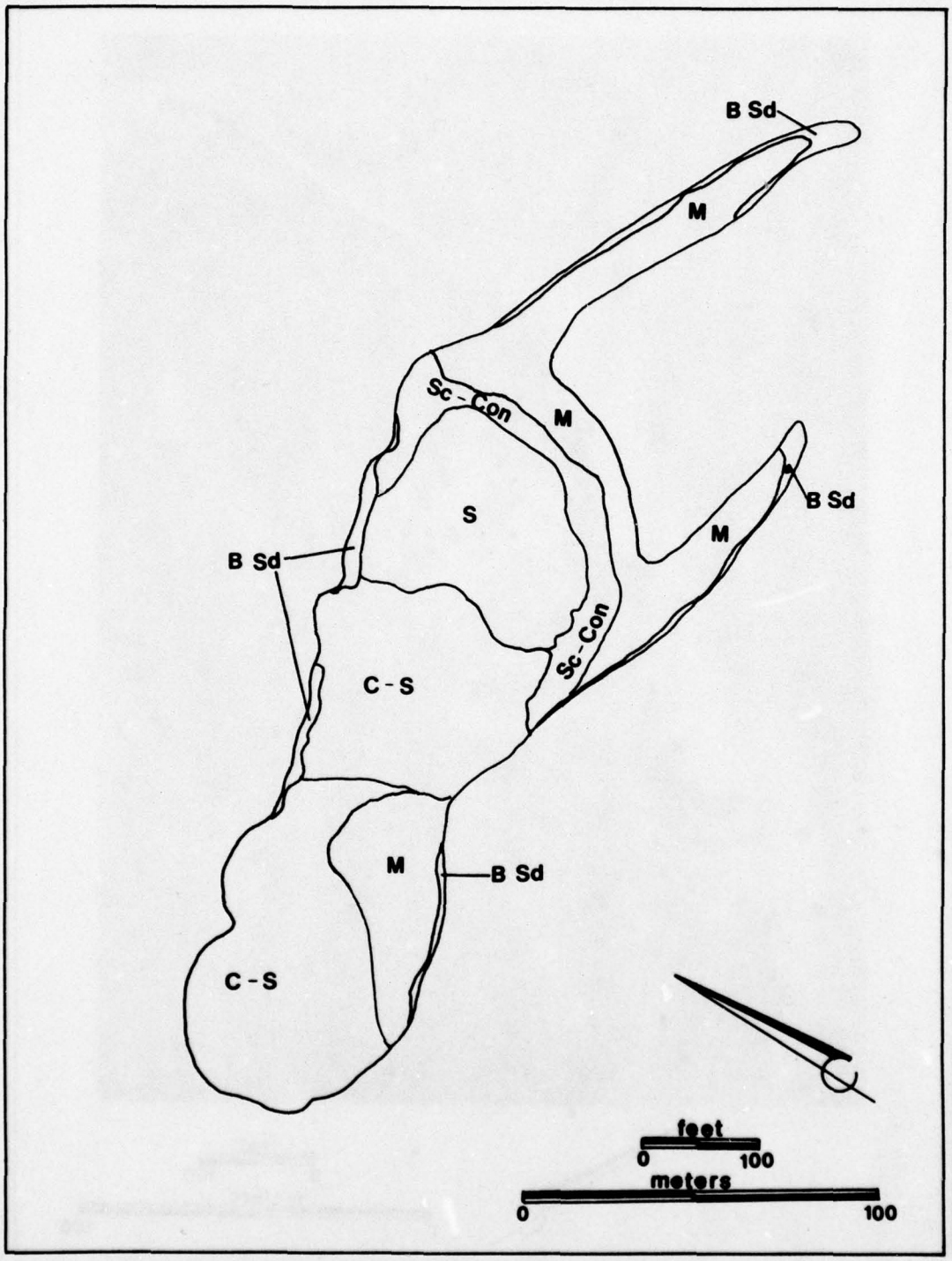

Figure 55. Vegetation map of dredged material island II-88.

Table 26

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-89

Study Area: II | Island Number: 89

Size: 4.5 ha | Age: 14 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=14 rel. freq.	herbaceous N=14 abun.	shrub N=19 rel. freq.	shrub N=19 abun.	tree N=0
Baccharis halimifolia	12	A	62	VA	
Batis maritima	24	VA			
Borrichia frutescens	20	VA			
Conocarpus erecta			3	U	
Heliotropium curassavicum	12	A	3	U	
Iva frutescens			3	U	
Juniperus silicicola			10	A	
Pluchea purpurascens			3	U	
Salicornia bigelovii	12	A			
Salicornia virginica	20	VA			
Schinus terebinthifolius			14	A	

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Figure 56. Vertical aerial photograph of dredged material island II-89.

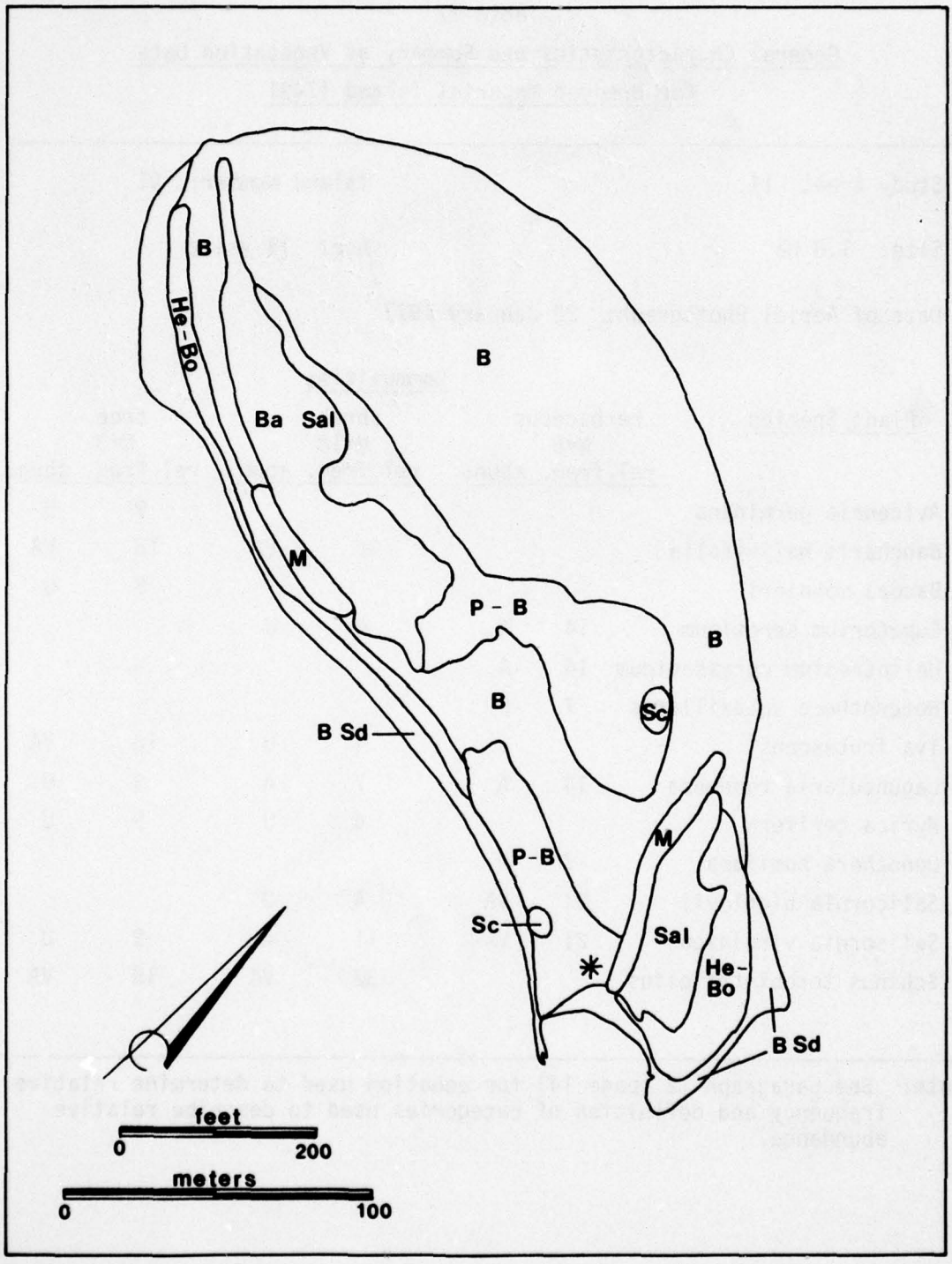

Figure 57. Vegetation map of dredged material island II-89.

Table 27

General Characteristics and Summary of Vegetation Data
For Dredged Material Island II-91

Study Area: II | Island Number: 91

Size: 1.8 ha | Age: 14 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=8 rel.freq.	herbaceous N=8 abun.	shrub N=18 rel.freq.	shrub N=18 abun.	tree N=3 rel.freq.	tree N=3 abun.
Avicennia germinans					9	U
Baccharis halimifolia			36	VA	18	VA
Bacopa monnieri					9	U
Eupatorium serotinum	14	A	4	U		
Heliotropium curassavicum	14	A				
Heterotheca subaxillaris	7	U				
Iva frutescens			4	U	18	VA
Laguncularia racemosa	14	A	7	A	9	U
Myrica cerifera			4	U	9	U
Oenothera humifusa	7	U				
Salicornia bigelovii	21	VA	4	U		
Salicornia virginica	21	VA	11	A	9	U
Schinus terebinthifolius			32	VA	18	VA

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

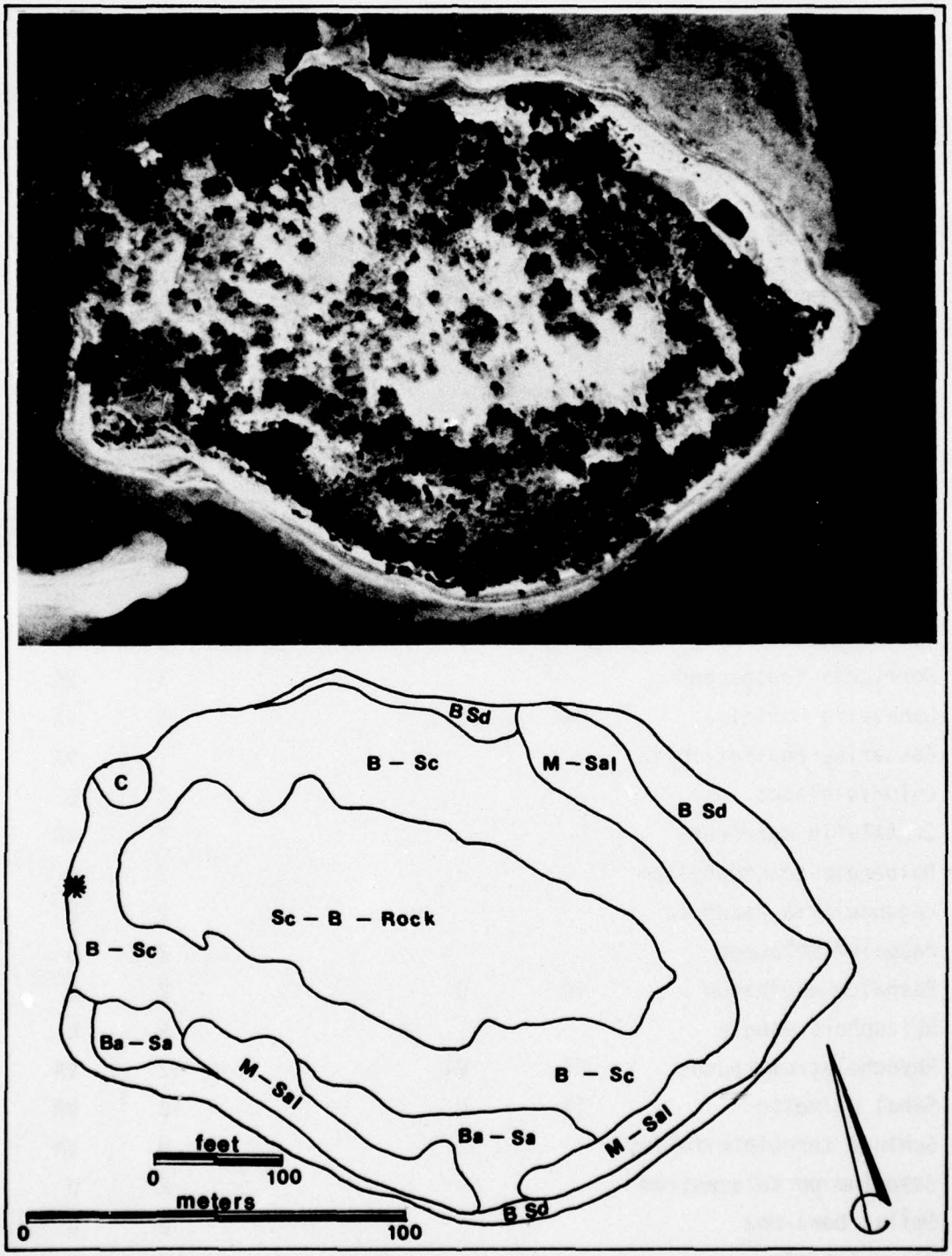

Figure 58. Vertical aerial photograph and vegetation map of dredged material island II-91.

Table 28

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-97

Study Area: II | Island Number: 97

Size: 0.9 ha | Age: 14 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=4 rel. freq.	abun.	shrub N=0	tree N=6 rel. freq.	abun.
Ambrosia artemisiifolia				7	VA
Andropogon glomeratus				5	VA
Andropogon virginicus				5	VA
Baccharis halimifolia				5	VA
Bidens pilosa				2	U
Borrichia frutescens				5	VA
Canavalia maritima	14	U		5	VA
Casuarina equisetifolia				7	VA
Chloris glauca				2	U
Crotalaria mucronata				7	VA
Dalbergia ecastophyllum				2	U
Laguncularia racemosa				2	U
Paspalum setaceum				2	U
Paspalum vaginatum	14	U		2	U
Rhizophora mangle				2	U
Rhynchelytrum repens	57	VA		12	VA
Sabal palmetto	14	U		12	VA
Schinus terebinthifolius				9	VA
Sesuvium portulacastrum				2	U
Smilax bona-nox				2	U
Vigna luteola				2	U

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

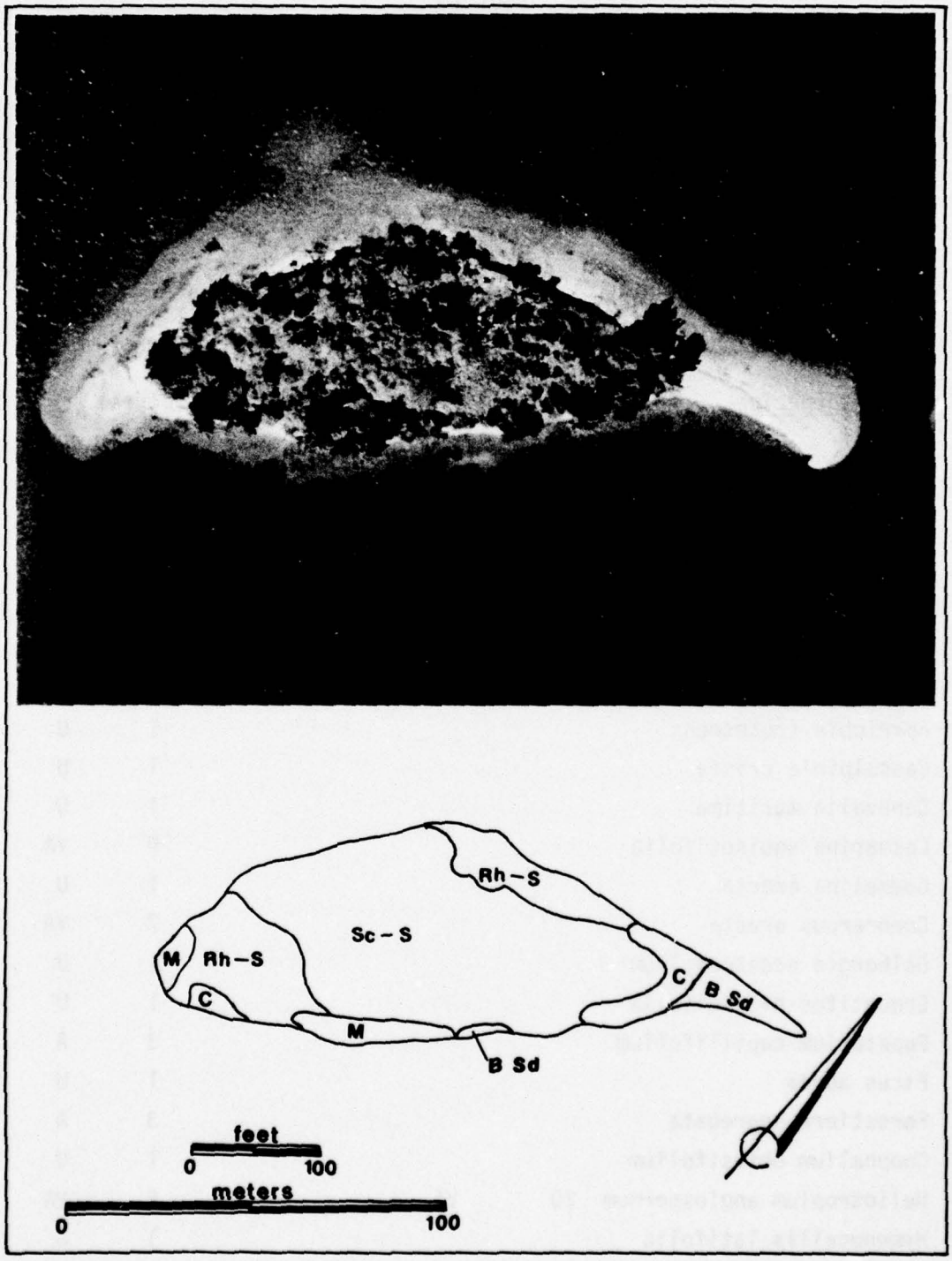

Figure 59. Vertical aerial photograph and vegetation map of dredged material island II-97.

Table 29

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-98

Study Area: II | Island Number: 98

Size: 1.6 ha | Age: 14 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=6 rel.	freq.	abun.	shrub N=0	tree N=14 rel.	freq.	abun.
Abrus precatorious					1		U
Ambrosia artemisiifolia					1		U
Amorpha herbacea					3		A
Andropogon virginicus					1		U
Avicennia germinans					4		A
Bidens pilosa	50		VA		7		VA
Borrichia frutescens					1		U
Caesalpinia crista					1		U
Canavalia maritima					1		U
Casuarina equisetifolia					9		VA
Commelina erecta					1		U
Conocarpus erecta					7		VA
Dalbergia ecastophyllum					1		U
Erechtites hieracifolia					1		U
Eupatorium capillifolium					3		A
Ficus aurea					1		U
Forestiera segregata					3		A
Gnaphalium obtusifolium					1		U
Heliotropium angiospermum	20		VA		8		VA
Hymenocallis latifolia					1		U

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 29 (Concluded)

Plant Species	Communities					
	herbaceous		shrub	tree		
	rel. freq.	abun.	N=0	rel. freq.	abun.	
Ipomoea alba				1	U	
Iva frutescens				1	U	
Laguncularia racemosa				3	A	
Myrcianthes fragrans				1	U	
Oxalis stricta				1	U	
Parthenocissus quinquefolia				1	U	
Passiflora lutea	10	A		1	U	
Poinsettia heterophylla				1	U	
Psidium guajava				1	U	
Rhizophora mangle				1	U	
Sabal palmetto				7	VA	
Schinus terebinthifolius	10	A		15	VA	
Senecio glabellus				1	U	
Sida rhombifolia	10	A				
Solanum americanum				3	A	
Sophora tomentosa				1	U	

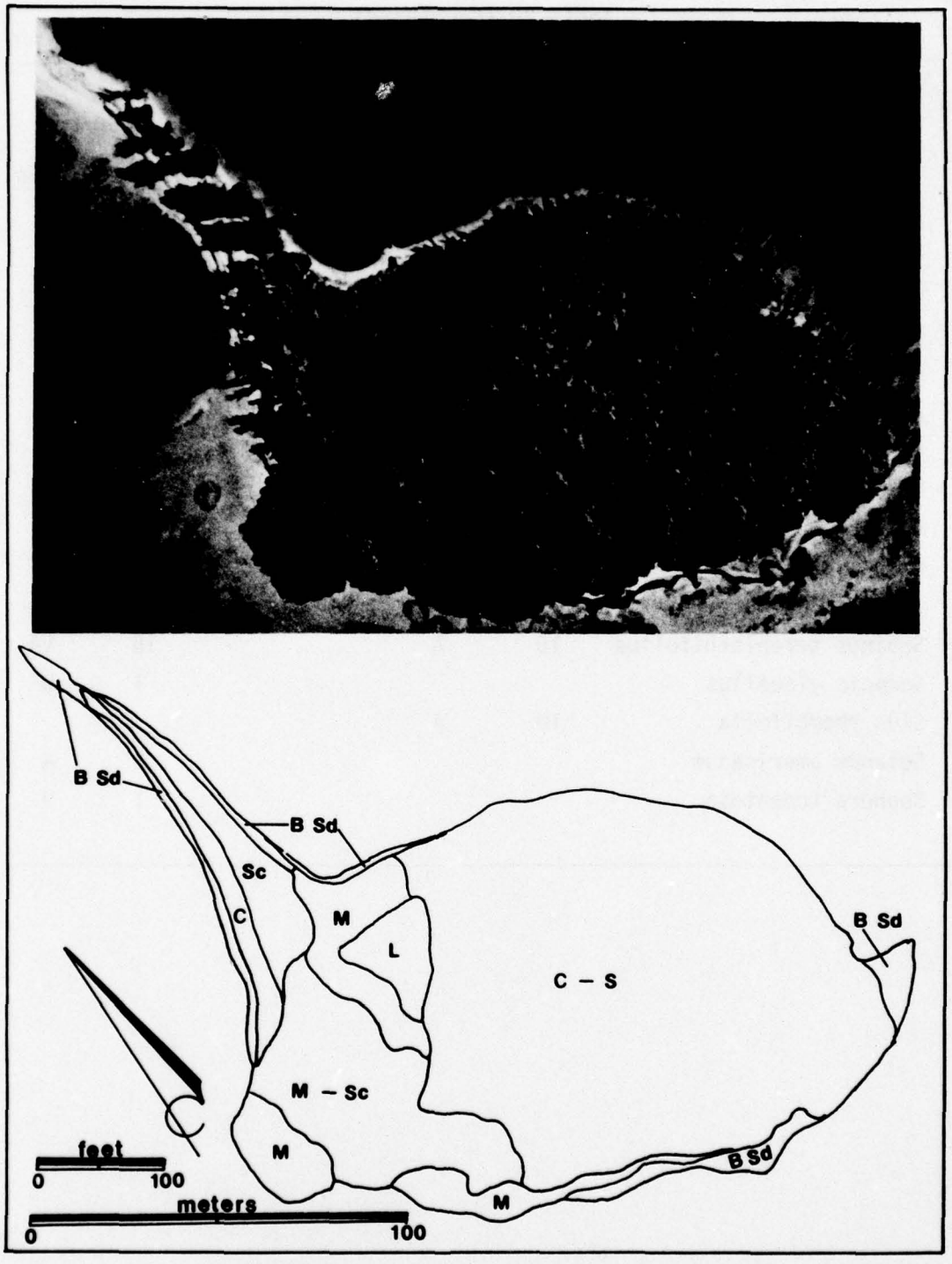

Figure 60. Vertical aerial photograph and vegetation map of dredged material island II-98.

Table 30

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-125

Study Area: II | Island Number: 125

Size: 1.3 ha | Age: 20 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=6 rel. freq.	herbaceous N=6 abun.	shrub N=0	tree N=4 rel. freq.	tree N=4 abun.
Avicennia germinans				4	U
Bidens pilosa				13	VA
Casuarina equisetifolia				13	VA
Chloris petraea	14	U			
Dalbergia ecastophyllum				8	VA
Forestiera segregata				4	U
Iva imbricata				4	U
Laguncularia racemosa				4	U
Limonium carolinianum	14	U			
Momordica charantia				4	U
Paspalum vaginatum	44	VA		8	VA
Philoxerus vermicularis	14	U		4	U
Phytolacca americana				4	U
Rhizophora mangle				4	U
Sabal palmetto				8	VA
Schinus terebinthifolius				13	VA
Sonchus oleraceus				4	U
Suaeda linearis	14	U			

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

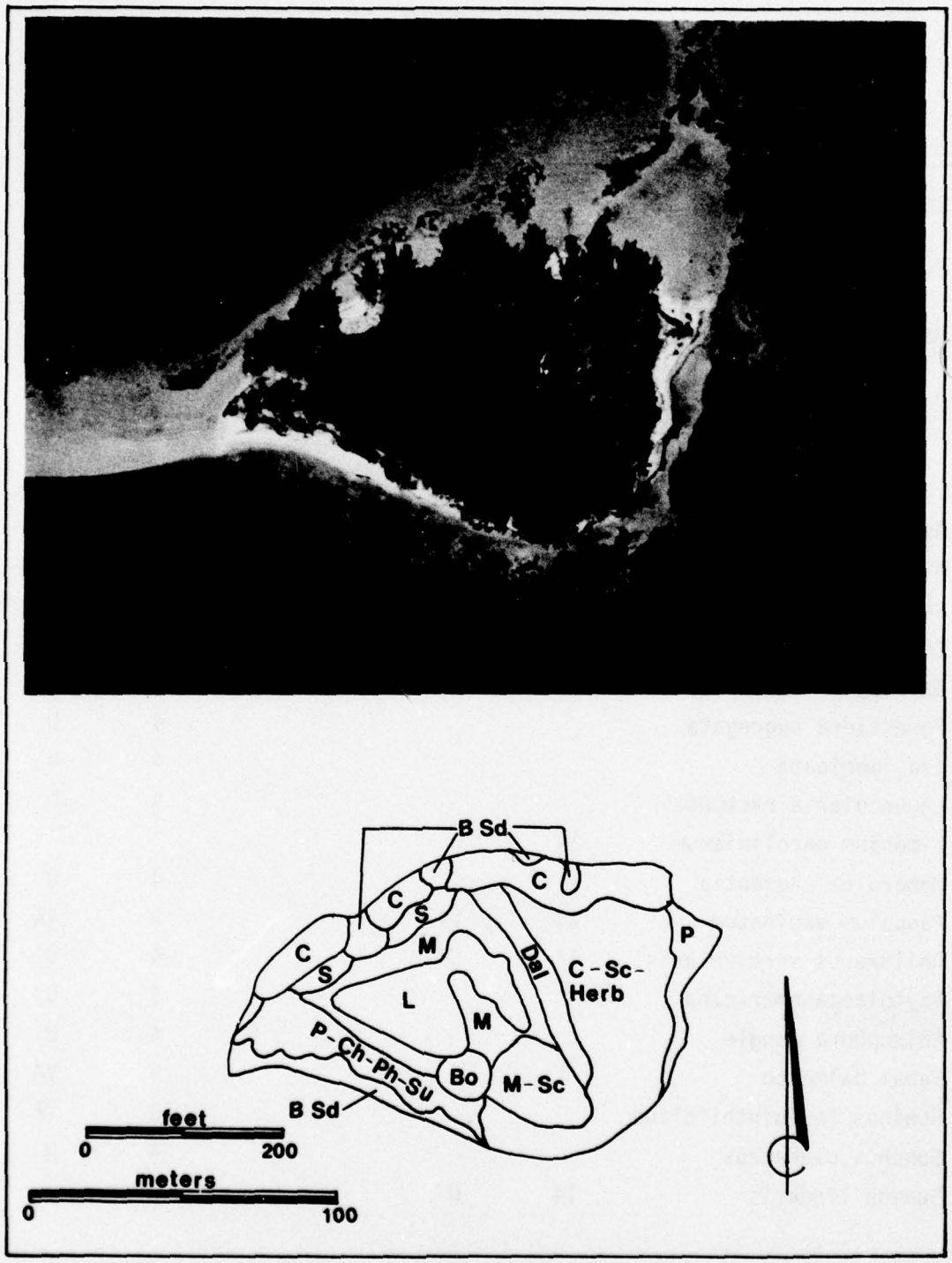

Figure 61. Vertical aerial photograph and vegetation map of dredged material island II-125.

Table 31

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-128

Study Area: II | Island Number: 128

Size: 1.4 ha | Age: 20 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=8 rel. freq.	herbaceous N=8 abun.	shrub N=0	tree N=3 rel. freq.	tree N=3 abun.
Avicennia germinans	10	U			
Baccharis halimifolia				6	U
Borrichia frutescens				6	U
Casuarina equisetifolia	10	U		6	U
Cenchrus tribuloides				6	U
Chloris glauca				6	U
Dalbergia ecastophyllum				6	U
Forestiera segregata				6	U
Ipomoea pes-caprae	20	A		6	U
Oenothera humifusa	10	U			
Paspalum vaginatum	29	VA			
Philoxerus vermicularis	20	A		6	U
Rhizophora mangle				6	U
Rhynchelytrum repens				6	U
Sabal palmetto				6	U
Schinus terebinthifolius				22	VA
Sesuvium portulacastrum				6	U

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

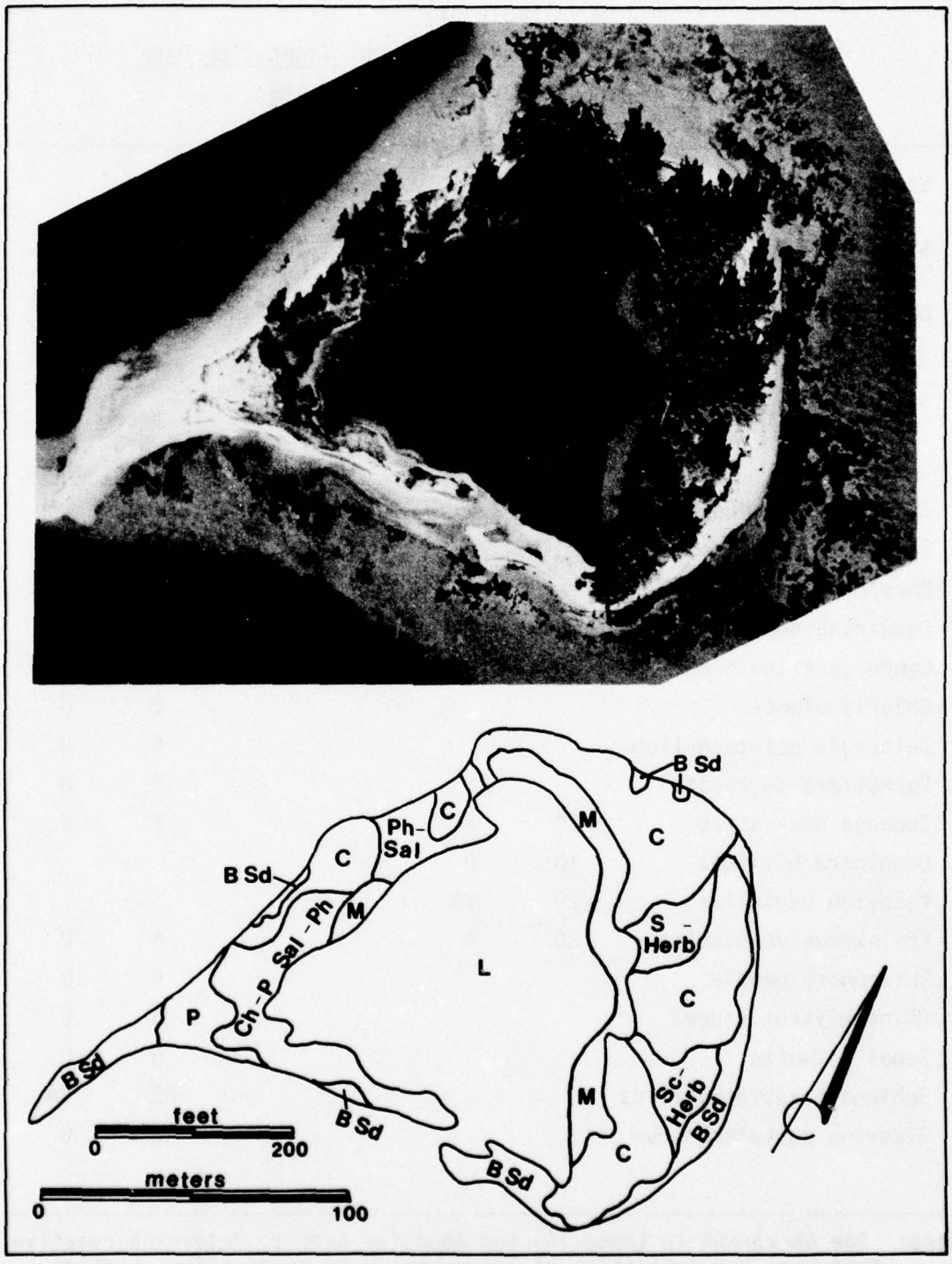

Figure 62. Vertical aerial photograph and vegetation map of dredged material island II-128.

Table 32

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-129

Study Area: II | Island Number: 129

Size: 1.2 ha | Age: 3 years

Date of Aerial Photograph: 22 January 1977

Plant Species	Communities: herbaceous N=21 rel. freq.	herbaceous N=21 abun.	shrub N=0	tree N=0
Atriplex arenaria	3	U		
Casuarina equisetifolia	3	U		
Cenchrus tribuloides	15	A		
Conyza canadensis	3	U		
Eupatorium capillifolium	3	U		
Ipomoea pes-caprae	3	U		
Iva imbricata	9	A		
Paspalum vaginatum	32	VA		
Sonchus oleraceus	3	U		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

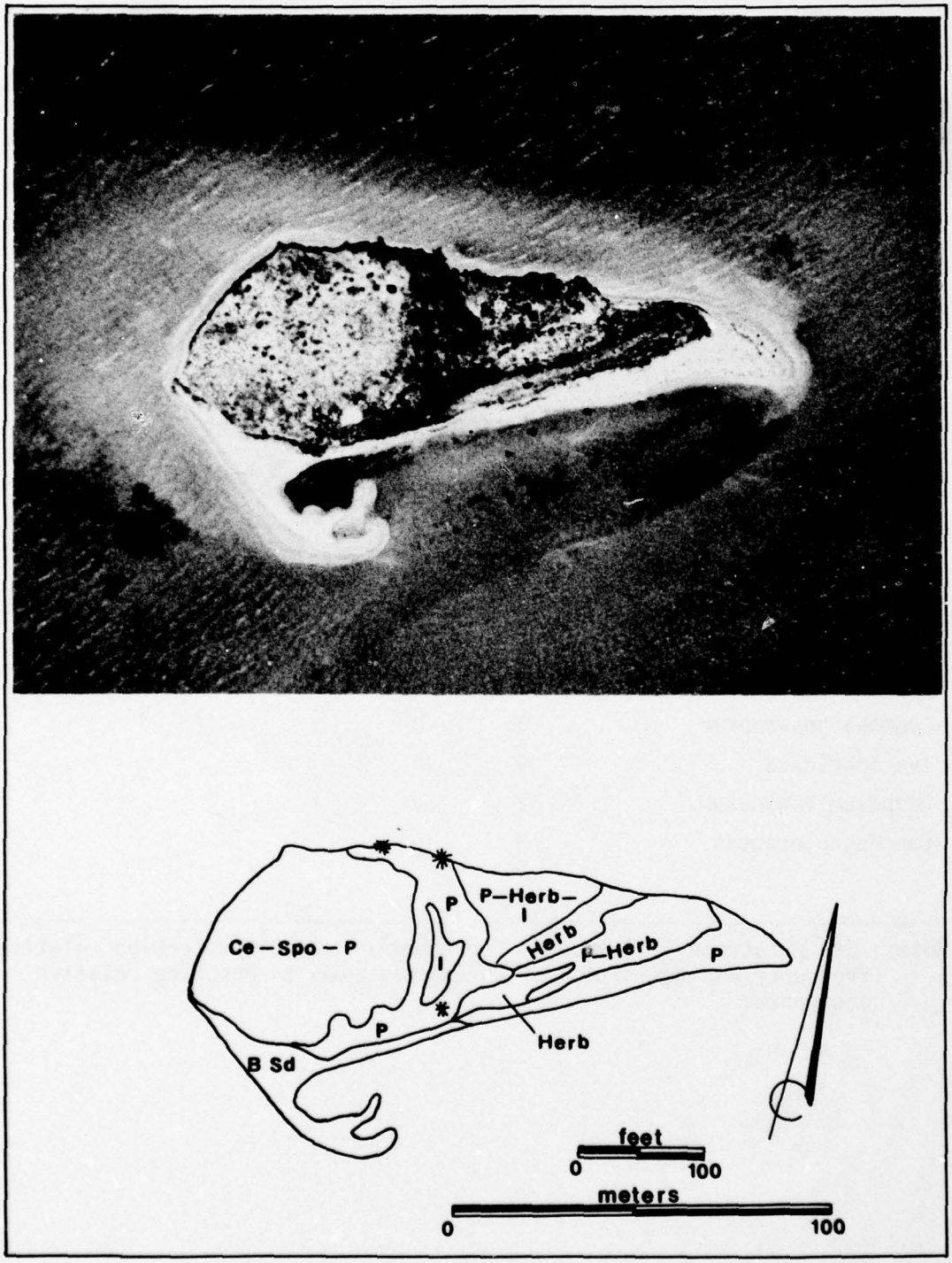

Figure 63. Vertical aerial photograph and vegetation map of dredged material island II-129.

Table 33

General Characteristics and Summary of Vegetation Data

For Dredged Material Island II-152

Study Area: II

Island Number: 152

Size: 0.5 ha

Age: 20 years

Date of Aerial Photograph: 22 January 1977

Plant Species	No Transects
Avicennia germinans	
Casuarina equisetifolia	
Laguncularia racemosa	
Rhizophora mangle	
Sabal palmetto	
Schinus terebinthifolius	
Suaeda linearis	

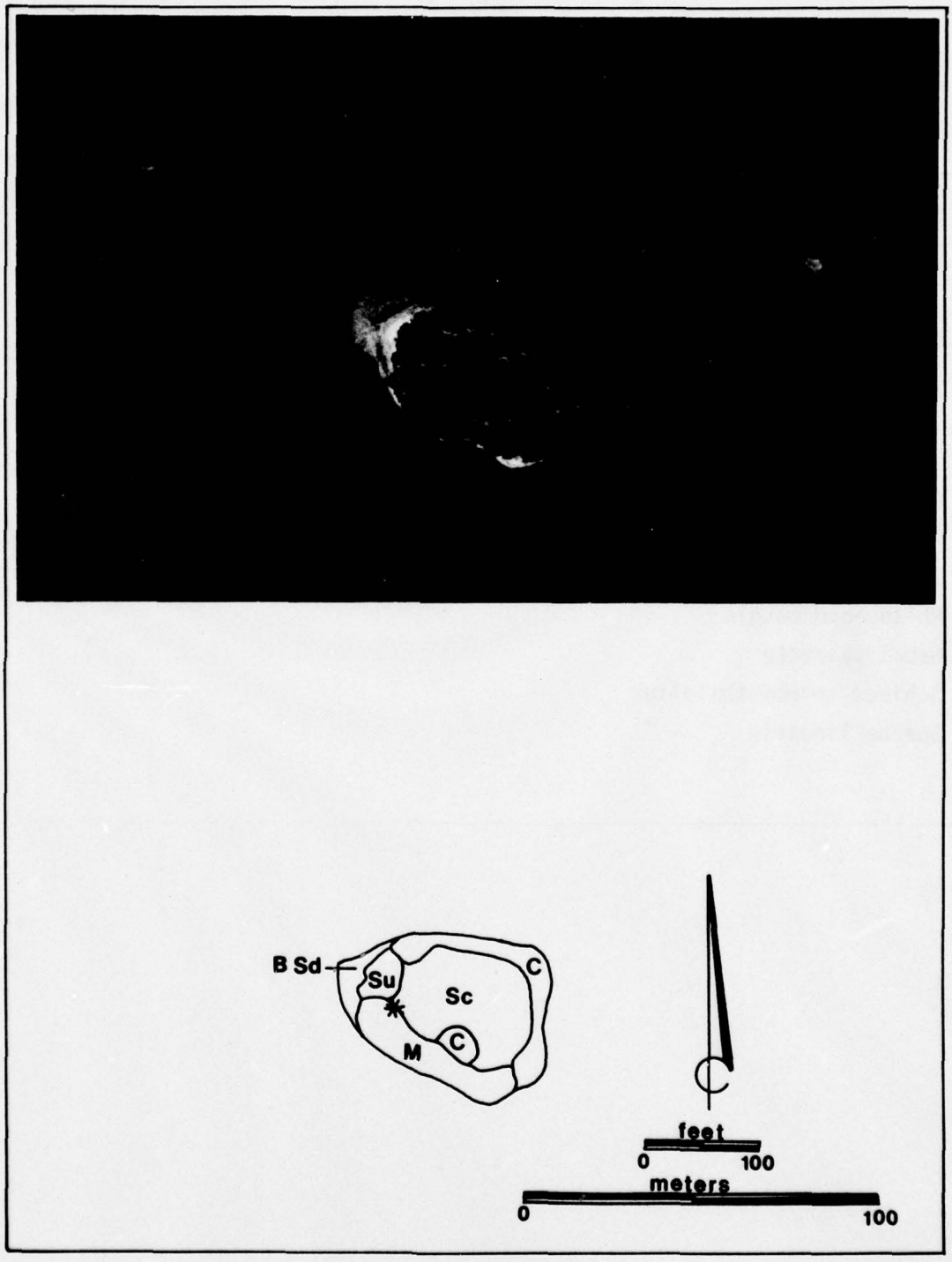

Figure 64. Vertical aerial photograph and vegetation map of dredged material island II-152.

Table 34

General Characteristics and Summary of Vegetation Data
For Dredged Material Island II-153

Study Area: II | Island Number: 153

Size: 0.6 ha | Age: 20 years

Date of Aerial Photograph: 22 January 1977

Plant Species	No transects
Avicennia germinans	
Casuarina equisetifolia	
Laguncularia racemosa	
Rhizophora mangle	
Sabal palmetto	
Schinus terebinthifolius	
Suaeda linearis	

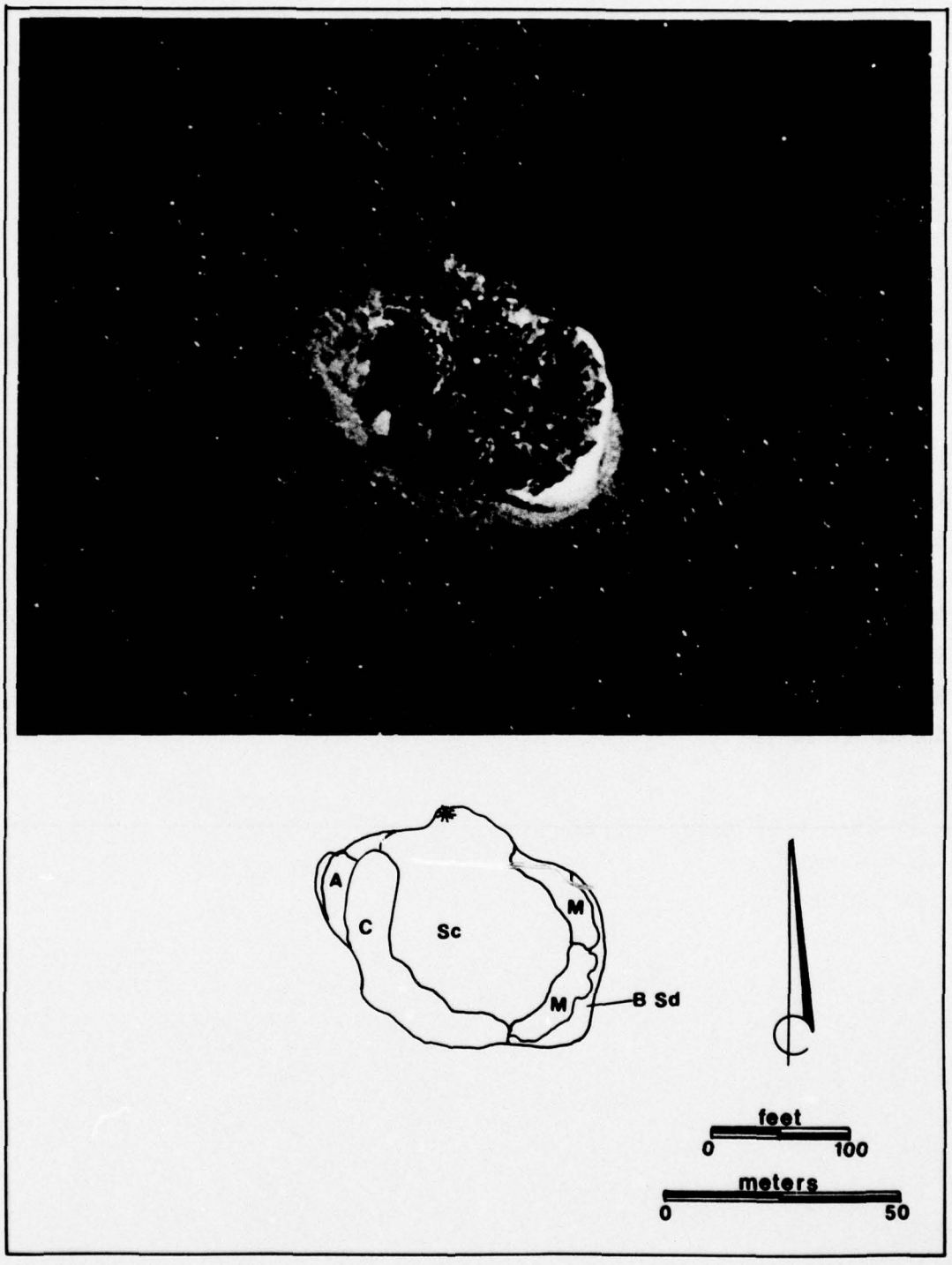

Figure 65. Vertical aerial photograph and vegetation map of dredged material island II-153.

Table 35

General Characteristics and Summary of Vegetation Data

For Dredged Material Island III-7

Study Area: III | Island Number: 7

Size: 0.3 ha | Age: 12 years

Date of Aerial Photograph: 26 March 1977

Plant Species	Communities: herbaceous N=21 rel. freq.	herbaceous N=21 abun.	shrub N=0	tree N=0
Andropogon virginicus	9	A		
Baccharis halimifolia	3	U		
Canavalia rosea	3	U		
Chloris glauca	3	U		
Eupatorium capillifolium	6	I		
Heterotheca subaxillaris	37	VA		
Oenothera humifusa	17	A		
Paspalum vaginatum	9	A		
Solanum americanum	3	U		
Sonchus oleraceus	3	U		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

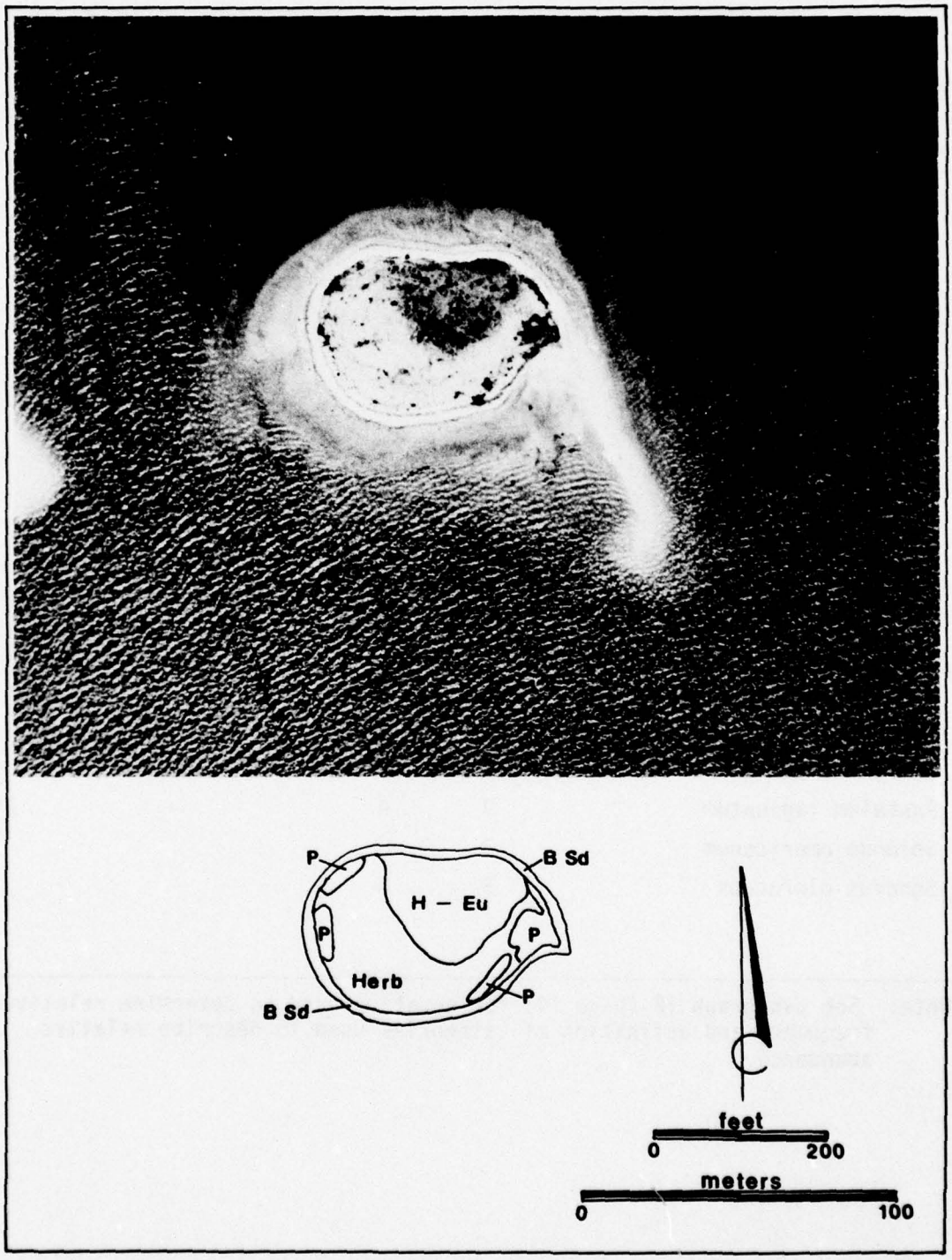

Figure 66. Vertical aerial photograph and vegetation map of dredged material island III-7.

Table 36

General Characteristics and Summary of Vegetation Data

For Dredged Material Island III-8

Study Area: III | Island Number: 8

Size: 2.5 ha | Age: 12 years

Date of Aerial Photograph: 26 March 1977

Plant Species	Communities: herbaceous N=78 rel. freq.	herbaceous N=78 abun.	shrub N=0	tree N=0
Andropogon virginicus	14	A		
Baccharis halimifolia	12	A		
Chloris glauca	22	VA		
Eupatorium capillifolium	5	I		
Flaveria floridana	2	I		
Heterotheca subaxillaris	6	I		
Ipomoea sagittata	1	U		
Lippia nodiflora	1	U		
Oenothera humifusa	1	U		
Paspalum vaginatum	9	A		
Salicornia virginica	4	I		
Scirpus robusta	3	I		
Sesuvium portulacastrum	8	A		
Sonchus oleraceus	3	I		
Sporobolus virginicus	9	A		
Suaeda linearis	1	U		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

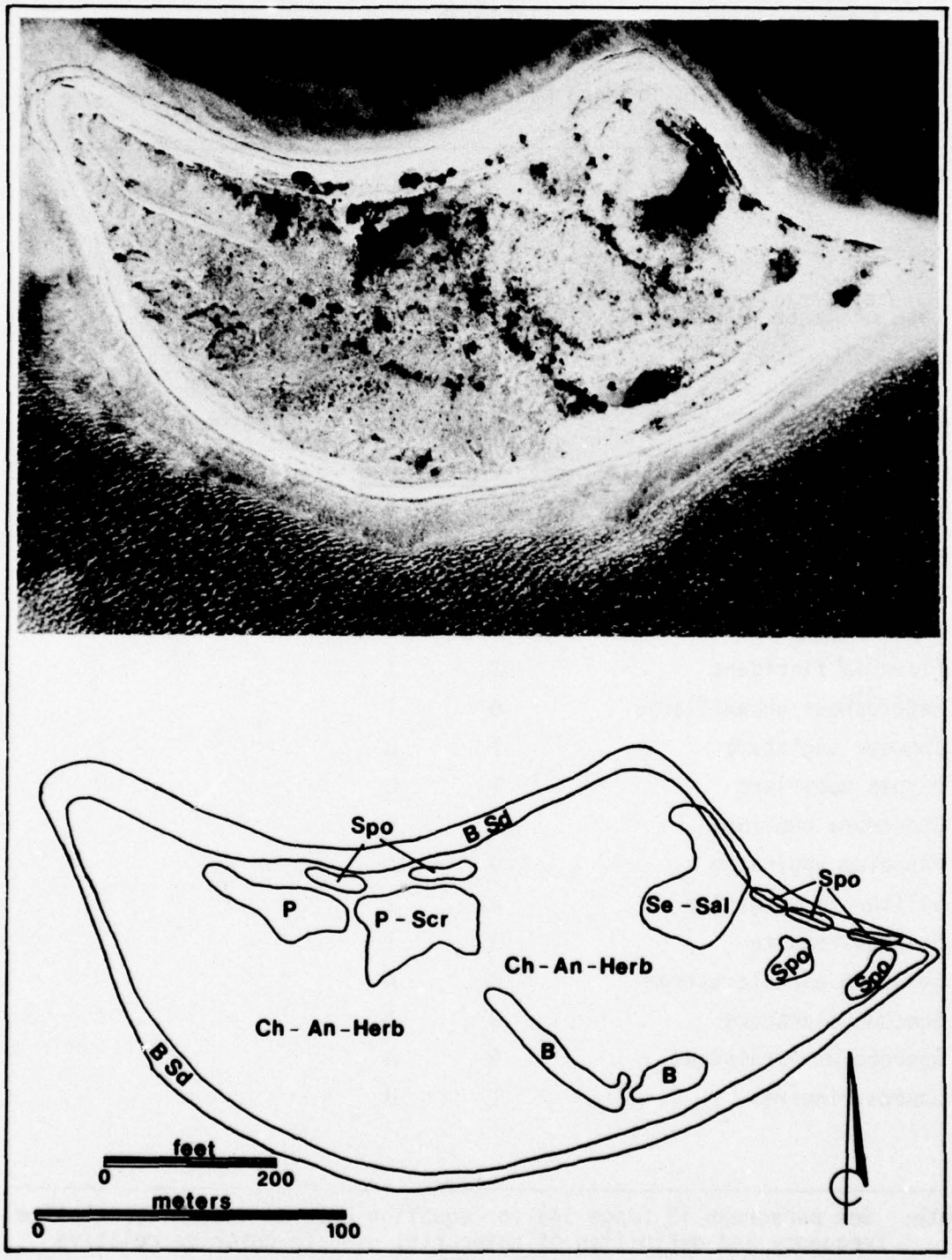

Figure 67. Vertical aerial photograph and vegetation map of dredged material island III-8.

Table 37

General Characteristics and Summary of Vegetation Data

For Dredged Material Island III-12

Study Area: III | Island Number: 12

Size: 0.1 ha | Age: 12 years

Date of Aerial Photograph: 26 March 1977

Plant Species	Communities: herbaceous N=17 rel. freq.	herbaceous N=17 abun.	shrub N=0	tree N=0
Baccharis halimifolia	4	U		
Boerhavia coccinea	12	A		
Chloris glauca	24	VA		
Erechtites hieracifolia	4	U		
Eupatorium capillifolium	12	A		
Sesuvium portulacastrum	4	U		
Sonchus oleraceus	12	A		
Sporobolus domingensis	28	VA		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

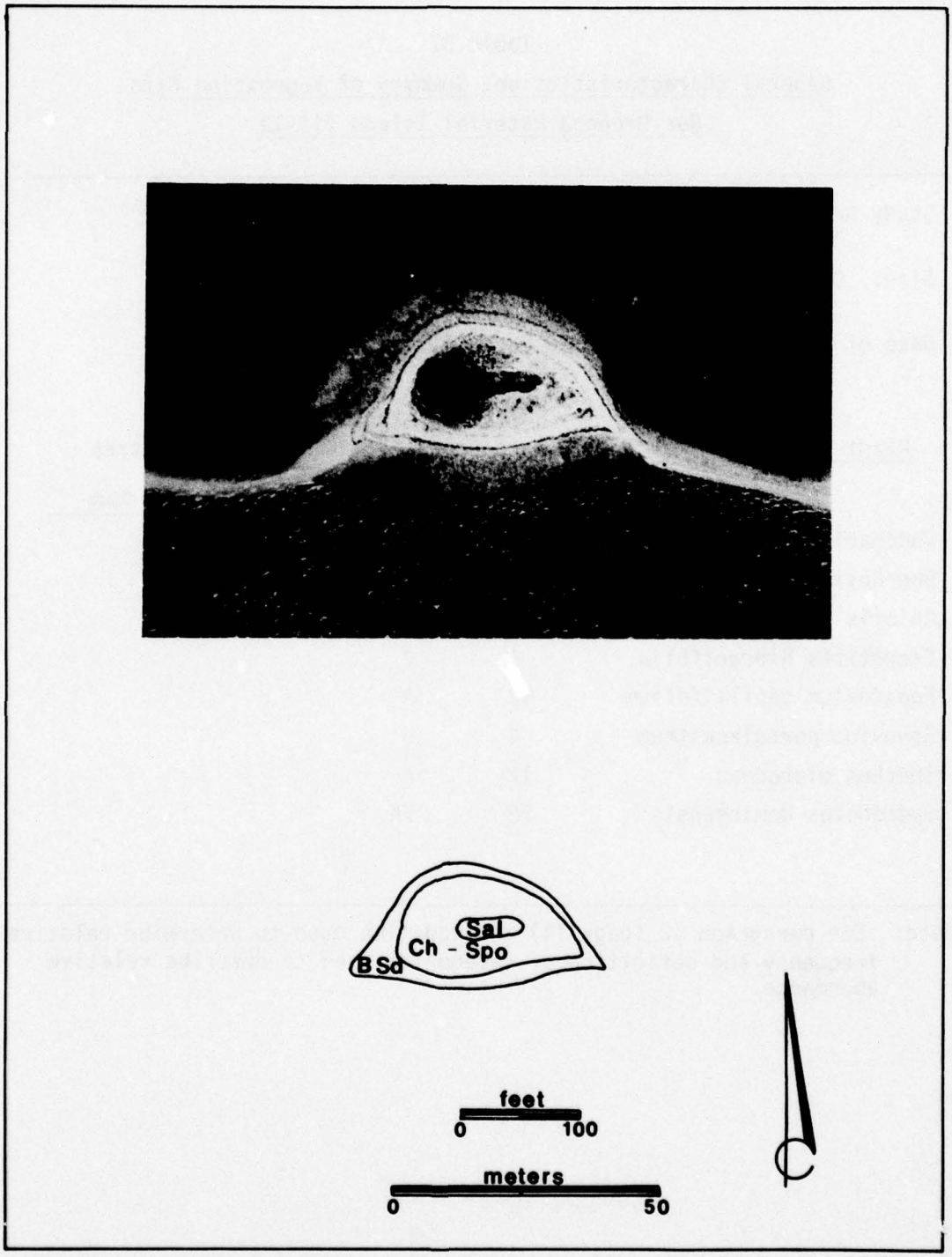

Figure 68. Vertical aerial photograph and vegetation map of dredged material island III-12.

Table 38

General Characteristics and Summary of Vegetation Data

For Dredged Material Island III-13

Study Area: III | Island Number: 13

Size: 0.2 ha | Age: 12 years

Date of Aerial Photograph: 26 March 1977

Plant Species	Communities: herbaceous N=4 rel. freq.	herbaceous N=4 abun.	shrub N=5 rel. freq.	shrub N=5 abun.	tree N=0
Baccharis halimifolia			21	VA	
Boerhavia coccinea	25	A	29	VA	
Eupatorium capillifolium			7	U	
Ipomoea trilobata			7	U	
Lepidium virginicum			7	U	
Sesuvium portulacastrum	75	VA			
Solanum americanum			7	U	
Sporobolus domingensis			7	U	
Stenotaphrum secundatum			14	VA	

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

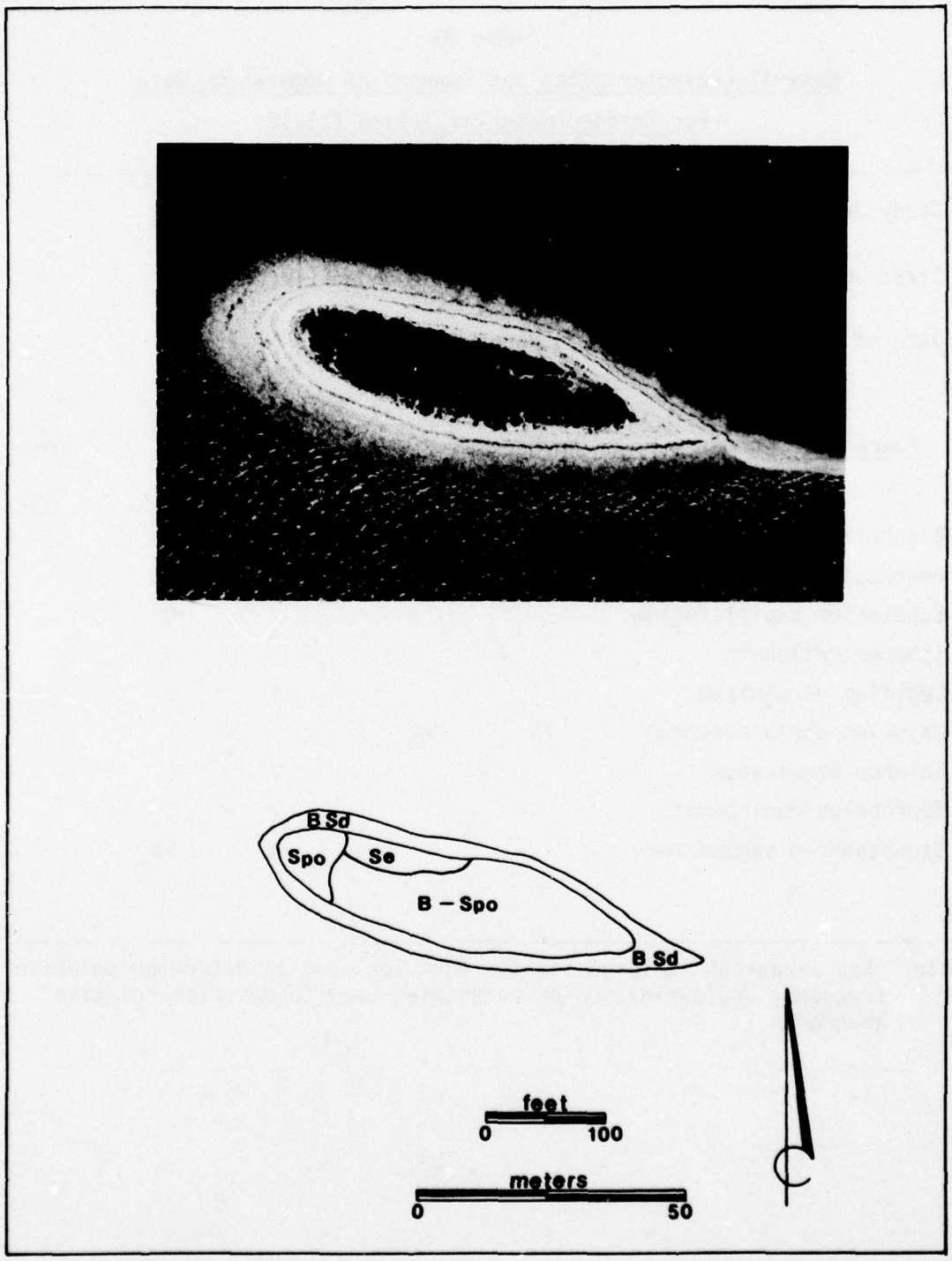

Figure 69. Vertical aerial photograph and vegetation map of dredged material island III-13.

Table 39

General Characteristics and Summary of Vegetation Data

For Dredged Material Island IV-1

Study Area: IV | Island Number: 1

Size: 1.0 ha | Age: 4 years

Date of Aerial Photograph: 27 March 1977

Plant Species	Communities: herbaceous N=33 rel. freq.	herbaceous N=33 abun.	shrub N=0	tree N=0
Atriplex arenaria	7	I		
Avicennia germinans	2	U		
Baccharis halimifolia	2	U		
Casuarina equisetifolia	2	U		
Chloris glauca	35	VA		
Heterotheca subaxillaris	24	VA		
Lepidium virginicum	2	U		
Paspalum vaginatum	2	U		
Portulaca pilosa	2	U		
Rhynchelytrum repens	15	A		
Sesuvium portulacastrum	2	U		
Sporobolus domingensis	4	I		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

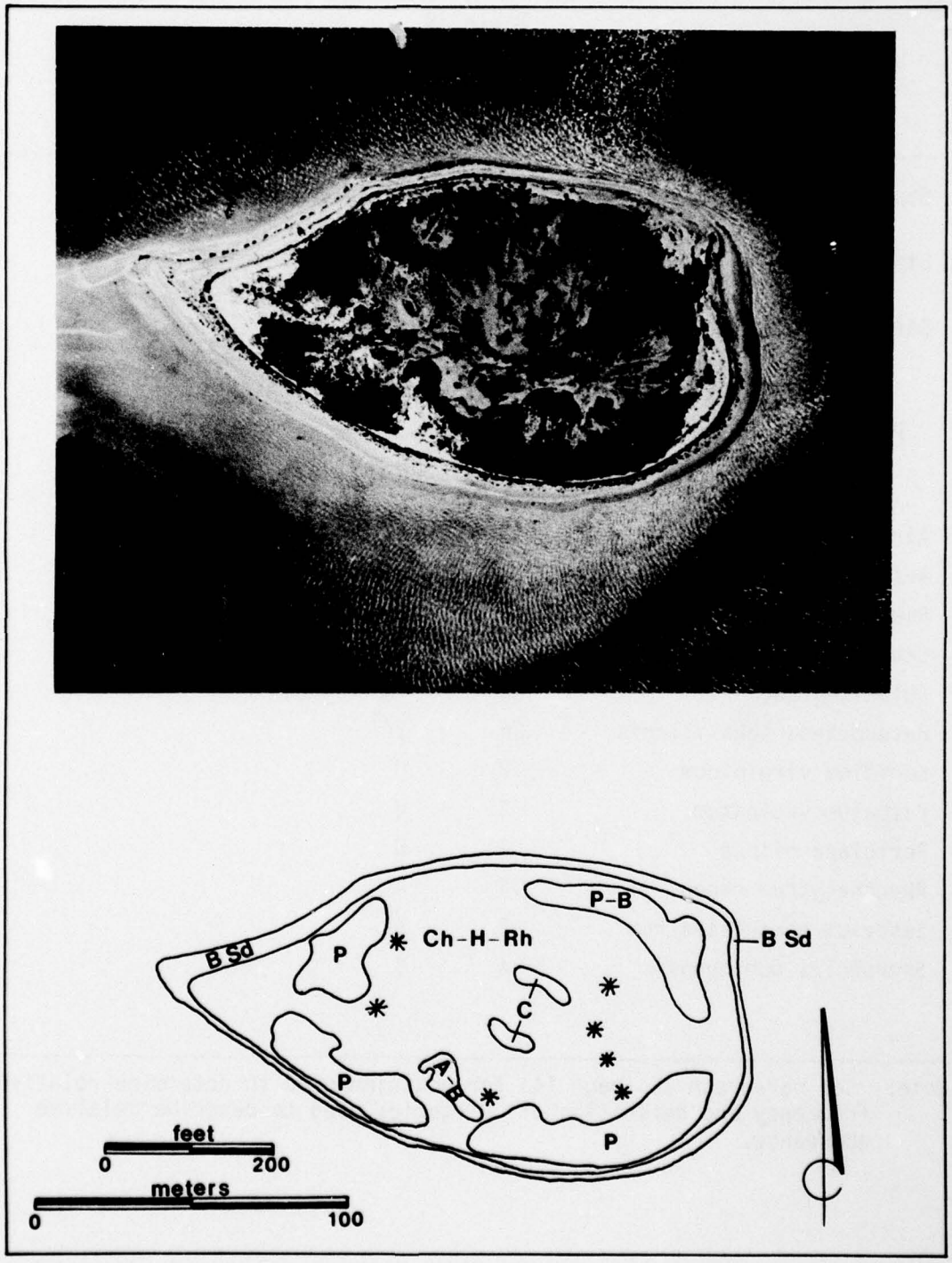

Figure 70. Vertical aerial photograph and vegetation map of dredged material island IV-1.

Table 40

General Characteristics and Summary of Vegetation Data

For Dredged Material Island V-1

Study Area: V | Island Number: 1

Size: 1.0 ha | Age: 40 years

Date of Aerial Photograph: 29 March 1977

Plant Species	Communities: herbaceous N=0	shrub N=0	tree N=11 rel. freq.	tree N=11 abun.
Bidens pilosa			5	A
Casuarina equisetifolia			12	VA
Cyperus ligularis			2	U
Dioscorea bulbifera			2	U
Ficus aurea			2	U
Ipomoea alba			5	U
Kalanchoe pinnata			19	VA
Laguncularia racemosa			5	A
Lantana camara			5	A
Parthenocissus quinquefolia			2	U
Poinsettia heterophylla			7	A
Rhizophora mangle			2	U
Rivina humilis			2	U
Sabal palmetto			7	A
Schinus terebinthifolius			17	VA
Solanum americanum			2	U
Terminalia catappa			2	U

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

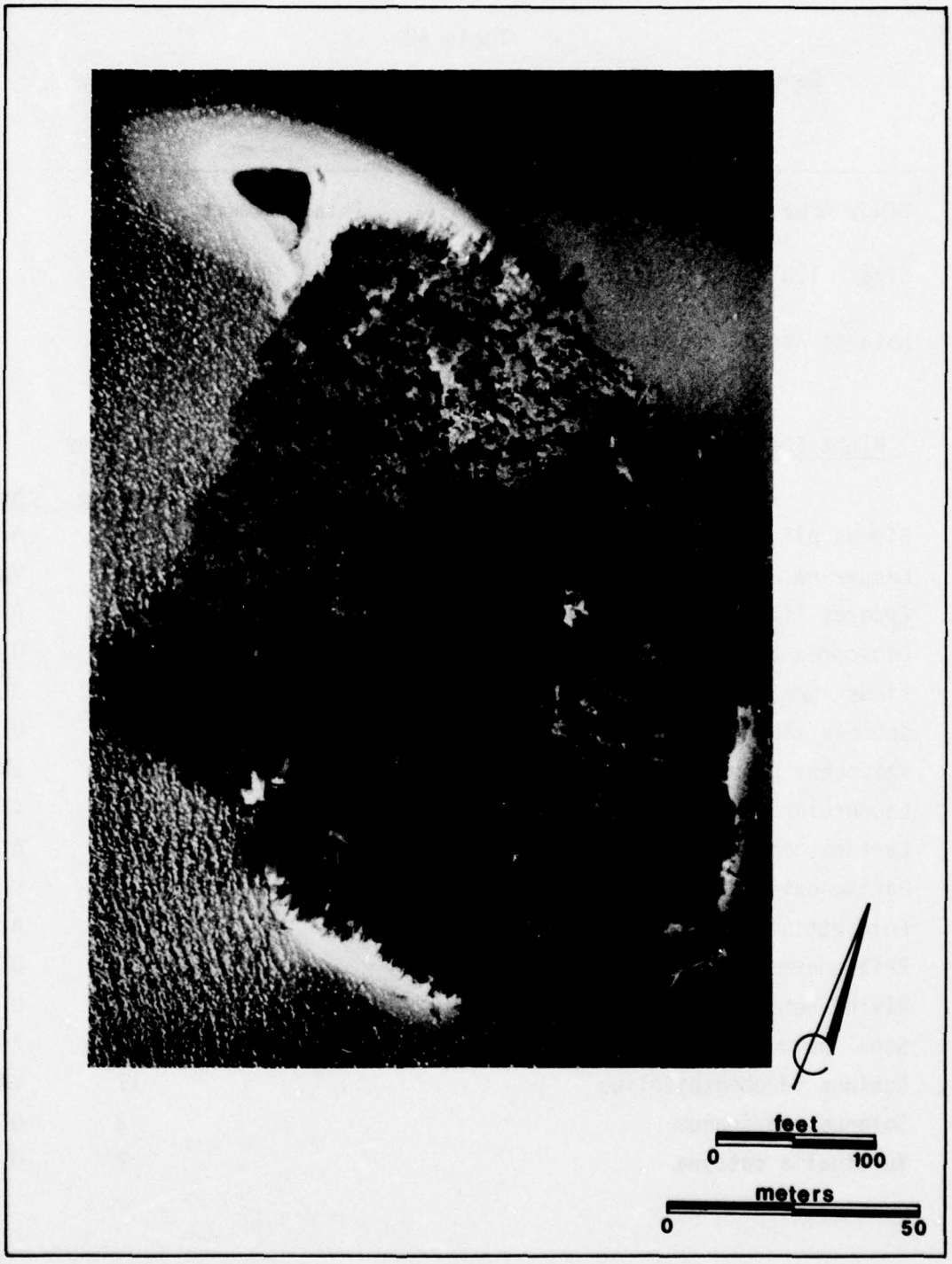

Figure 71. Vertical aerial photograph of dredged material island V-1.

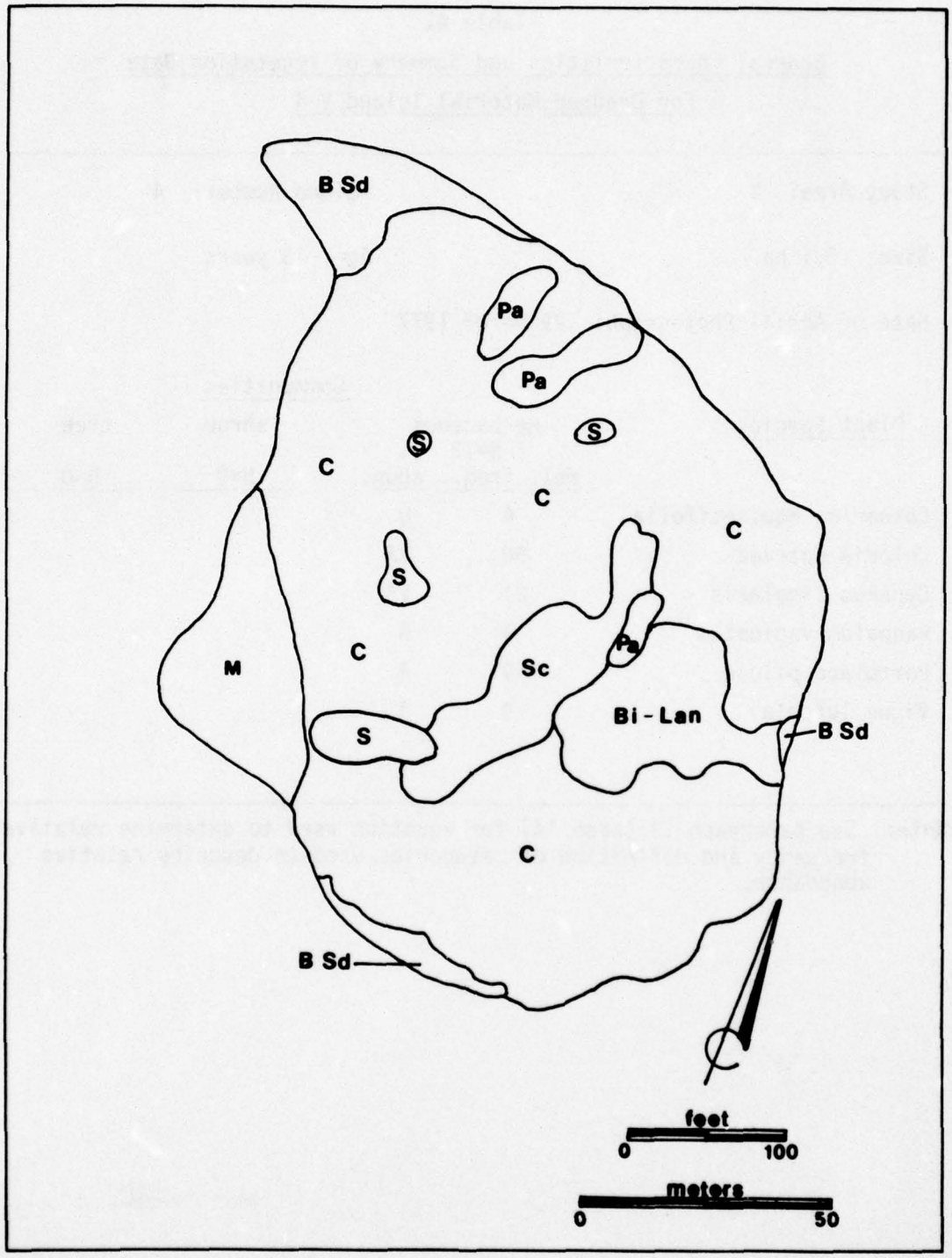

Figure 72. Vegetation map of dredged material island V-1.

Table 41

General Characteristics and Summary of Vegetation Data

For Dredged Material Island V-4

Study Area: V | Island Number: 4

Size: 0.1 ha | Age: 3 years

Date of Aerial Photograph: 29 March 1977

Plant Species	Communities: herbaceous N=12 rel. freq.	herbaceous abun.	shrub N=0	tree N=0
Casuarina equisetifolia	4	U		
Chloris petraea	50	VA		
Cyperus ligularis	21	VA		
Paspalum vaginatum	9	A		
Portulaca pilosa	9	A		
Vigna luteola	9	A		

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

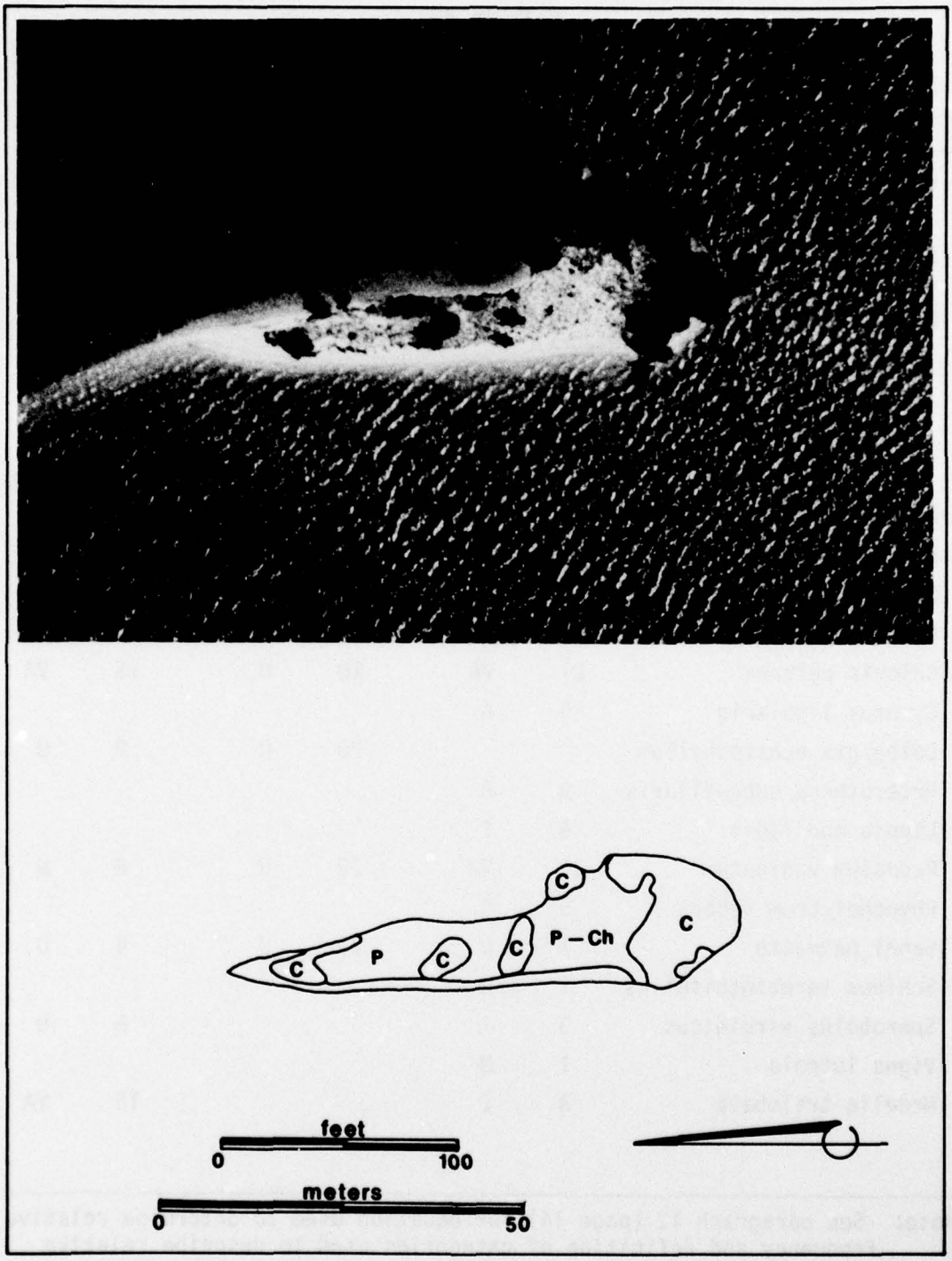

Figure 73. Vertical aerial photograph and vegetation map of dredged material island V-4.

Table 42

General Characteristics and Summary of Vegetation Data

For Dredged Material Island V-7

Study Area: V

Island Number: 7

Size: 0.9 ha

Age: 3 years

Date of Aerial Photograph: 29 March 1977

Plant Species	Communities: herbaceous N=29 rel.freq.	abun.	shrub N=1 rel.freq.	abun.	tree N=2 rel.freq.	abun.
Andropogon virginicus			20	U	15	VA
Baccharis halimifolia					8	U
Casuarina equisetifolia	1	U			15	VA
Cenchrus tribuloides	25	VA				
Chloris petraea	21	VA	20	U	15	VA
Cyperus ligularis	5	A				
Dalbergia ecastophyllum			20	U	8	U
Heterotheca subaxillaris	9	A				
Lippia nodiflora	4	I				
Paspalum vaginatum	21	VA	20	U	8	U
Rhynchelytrum repens	6	A				
Sabal palmetto	1	U	20	U	8	U
Schinus terebinthifolius	1	U				
Sporobolus virginicus	3	I			8	U
Vigna luteola	1	U				
Wedelia trilobata	3	I			15	VA

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

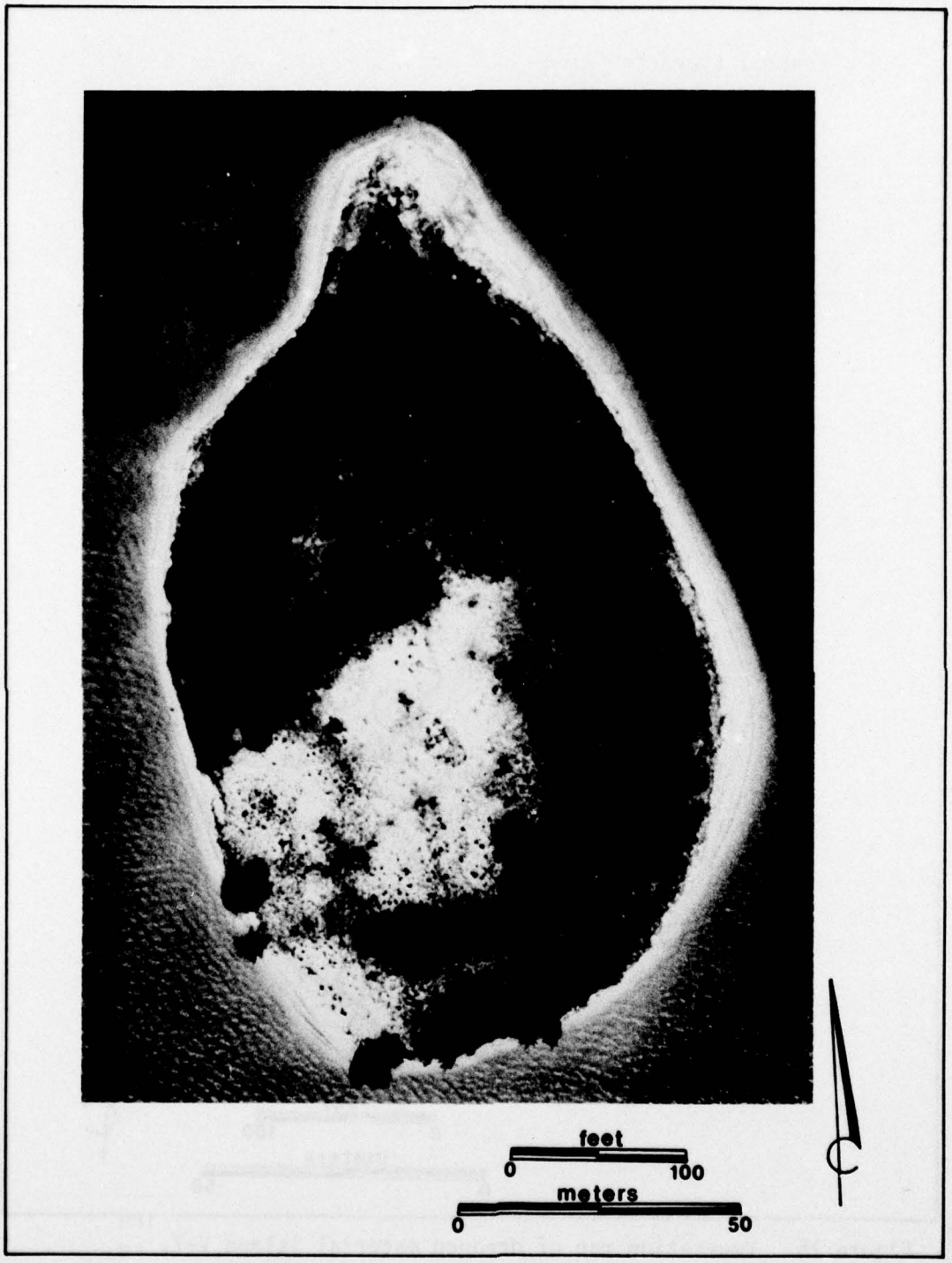

Figure 74. Vertical aerial photograph of dredged material island V-7.

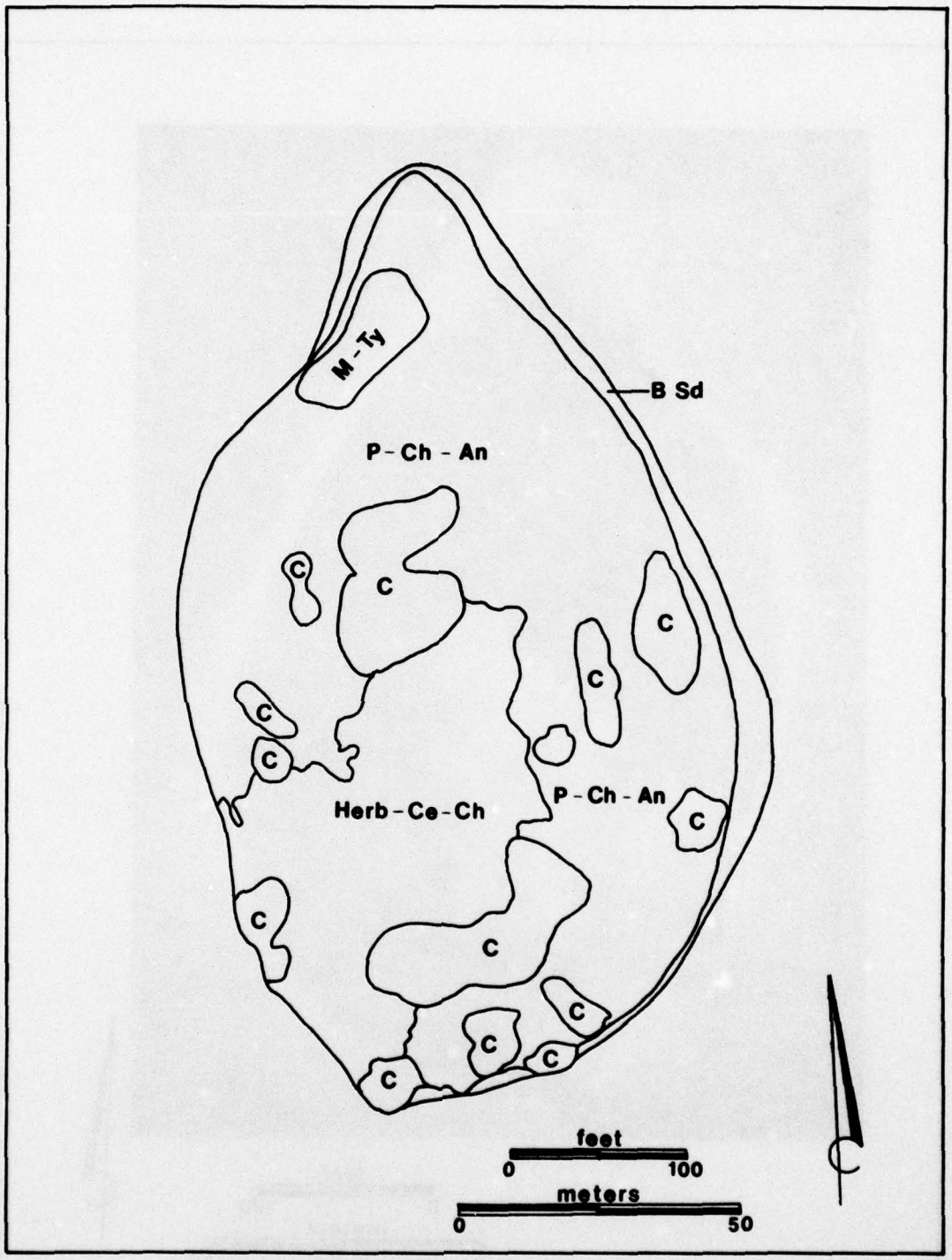

Figure 75. Vegetation map of dredged material island V-7.

Table 43

Major Plant Species Associated With The Generalized Plant Succession Pattern On Dredged Material Islands in Florida

Year	Plant Species
0	
3	Paspalum vaginatum
	Chloris glauca
	Rhyncheletrum repens
	Sporobolus poiretii
	Sporobolus domingensis
	Cenchrus spp.
	Spartina alterniflora
5	All of the above plus:
	Oenothera humifusa
	Heterotheca subaxillaris
	Baccharis halimifolia
	Iva frutescens
	Schinus terebinthifolius
	Laguncularia racemosa
10	Baccharis halimifolia
	Schinus terebinthifolius
	Paspalum vaginatum
	Heterotheca subaxillaris
	Oenothera humifusa
	Sabal palmetto
	Casuarina equisetifolia
	Avicennia germinans
	Laguncularia racemosa
20	Schinus terebinthifolius

(Continued)

Note: See paragraph 12 (page 14) for equation used to determine relative frequency and definition of categories used to describe relative abundance.

Table 43 (Concluded)

Year	Plant Species
20	Sabal palmetto
	Casuarina equisetifolia
	Paspalum vaginatum
	Avicennia germinans
	Laguncularia racemosa
	Rhizophora mangle
	Conocarpus erecta
40+	Casuarina equisetifolia
	Sabal palmetto
	Schinus terebinthifolius
	Avicennia germinans
	Laguncularia racemosa
	Rhizophora mangle

Table 44
Plant Species Checklist

Scientific Name	Common Name
GYMNOSPERMAE	
PINACEAE	
Pinus elliottii Englem.	Slash pine
CUPRESSACEAE	
Juniperus silicicola (Small) Bailey	Southern red cedar
ANGIOSPERMAE	
POACEAE	
Andropogon glomeratus (Walt.) BSP	Bushy beard grass
Andropogon virginicus L.	Broomsedge
Cenchrus incertus M. A. Curtis	Coast sandspur
Cenchrus pauciflorus Benth.	Field sandspur
Cenchrus tribuloides L.	Dune sandspur
Chloris glauca (Chapm.) Wood	Finger grass
Chloris petraea Sw.	Finger grass
Cynodon dactylon Pers.	Bermuda grass
Panicum amarum Ell.	Beach grass
Paspalum setaceum Michx.	Paspalum
Paspalum urvillei Steud.	Vasey grass
Paspalum vaginatum Sw.	Seaside paspalum
Rhynchelytrum repens (Willd.) C. E. Hubbard	Natal grass
Spartina alterniflora Loisel.	Smooth cordgrass
Spartina patens (Ait.) Muhl.	Saltmeadow cordgrass
Sporobolus domingensis (Trin.) Kunth	Dropseed
Sporobolus poiretii (R. & S.) Hitch.	Smutgrass
Sporobolus virginicus (L.) Kunth	Virginia dropseed

(Continued)

Table 44 (Continued)

Stenotaphrum secundatum (Walt.) Kuntze	St. Augustine grass
Triplasis purpurea (Walt.) Chapm.	Purple sandgrass
Uniola paniculata L.	Sea oats
CYPERACEAE	
Cladium jamaicense Crantz	Saw grass
Cyperus ligularis L.	Nutsedge
Cyperus planifolius Richard	Nutsedge
Cyperus polystachyos Rottb.	Nutsedge
Eleocharis baldwinii (Torr.) Chapm.	Spikerush
Fimbristylis spadicea (L.) Vahl.	Fringe grass
Scirpus robustus Pursh	Softstem bulrush
ARECACEAE	
Phoenix reclinata L.	Reclinata palm
Sabal palmetto (Walt.) Lodd. ex Schultes	Cabbage palm
Serenoa repens (Bartr.) Small	Saw palmetto
Washingtonia robusta Wendl.	Washington palm
COMMELINACEAE	
Commelina erecta L.	Slender dayflower
SMILACACEAE	
Smilax bona-nox L.	Greenbrier
AGAVACEAE	
Yucca aloifolia L.	Spanish bayonet
AMARYLLIDACEAE	
Hymenocallis latifolia (Mill.) Roem.	Spider lily
DIOSCOREACEAE	
Dioscorea bulbifera L.	Air potato
CASUARINACEAE	
Casuarina equisetifolia Forst.	Australian pine

(Continued)

Table 44 (Continued)

MYRICACEAE	
Myrica cerifera L.	Wax myrtle
BATACEAE	
Batis maritima L.	Saltwort
ULMACEAE	
Celtis laevigata Willd.	Hackberry
MORACEAE	
Ficus aurea Nutt.	Strangler fig
Morus rubra L.	Red mulberry
URTICACEAE	
Parietaria praetermissa Hinton	Pellitory
CHENOPODIACEAE	
Atriplex arenaria Nutt.	Orach
Chenopodium ambrosioides L.	Mexican tea
Salicornia bigelovii Torr.	Bigelow's glasswort
Salicornia virginica L.	Woody glasswort
Suaeda linearis (Ell.) Mog.	Sea blite
AMARANTHACEAE	
Iresine celosia L.	Bloodleaf
Philoxerus vermicularis (L.) R. Brown	Saltweed
NYCTAGINACEAE	
Boerhavia coccinea Mill.	Red spiderling
PHYTOLACCACEAE	
Phytolacca americana L.	Pokeweed
Rivina humilis L.	Rouge plant
AZIOACEAE	
Sesuvium portulacastrum L.	Sea purselane
PORTULACACEAE	
Portulaca pilosa L.	Pink purselane

(Continued)

Table 44 (Continued)

BRASSICACEAE	
Cakile fusiformis Greene	Sea rocket
Lepidium verginicum L.	Pepper grass
CRASSULACEAE	
Kalanchoe pinnata Pers.	Cathedral bells
FABACEAE	
Abrus precatorious L.	Crab's eye
Amorpha herbacea Walt.	Lead plant
Caesalpinia crista L.	Gray nicker bean
Canavalia rosea L.	Bay bean
Clitoria ternatea L.	Blue pea
Crotalaria mucronata Desv.	Rattlebox
Dalbergia ecastophyllum (L.) Benth.	Dalbergia
Melilotus indica L.	Sweet clover
Sophora tomentosa L.	Necklace pod
Vigna luteola (Jacq.) Benth.	Cow pea
OXALIDACEAE	
Oxalis stricta L.	Yellow wood sorrel
RUTACEAE	
Citrus sinensis (L.) Osbeck	Sweet orange
Zanthoxylum clava-herculis L.	Hercules club
MELIACEAE	
Melia azedarach L.	Chinaberry
EUPHORBIACEAE	
Chamaesyce blodgetti (Engelm. ex Hitchc.) Small	Spurge
Cnidoscolus stimulosus (Michx.) Engelm. & Gray	Tread softly
Poinsettia heterophylla (L.) Kl. and Gke.	Painted leaf
ANACARDIACEAE	
Schinus terebinthifolius Raddi	Brazilian pepper tree

(Continued)

Table 44 (Continued)

SAPINDACEAE	
Dodonaea viscosa (L.) Jacq.	Varnish leaf
VITACEAE	
Ampelopsis arborea (L.) Rusby	Pepper vine
Parthenocissus quinquefolia (L.) Planchon	Virginia creeper
MALVACEAE	
Kosteletzkya virginica Presl ex Gray	Salt marsh mallow
Sida acuta Burm.	False mallow
Sida rhombifolia L.	False mallow
PASSIFLORACEAE	
Passiflora lutea L.	Passion flower
CACTACEAE	
Opuntia stricta Haw.	Prickly pear cactus
RHIZOPHORACEAE	
Rhizophora mangle L.	Red mangrove
COMBRETACEAE	
Conocarpus erecta L.	Buttonwood
Laguncularia racemosa Gaertn. f.	White mangrove
Terminalia catappa L.	Indian almond
MYRTACEAE	
Psidium guajava L.	Guava
Myricanthes fragrans (Sw.) McVaugh	Nakedwood
ONOGRACEAE	
Oenothera humifusa Nutt.	Seaside evening primrose
Oenothera laciniata Hill.	Seaside evening primrose
APIACEAE	
Hydrocotyle bonariensis Lam.	Water pennywort
PLUMBAGINACEAE	
Limonium carolinianum (Walt.) Britt.	Sea lavender

(Continued)

Table 44 (Continued)

APOCYNACEAE	
Catharanthus roseus (L.) G. Don	Madacascar periwinkle
ASCLEPIADACEAE	
Cynanchum palustre (Pursh) Heller	Vine milkweed
CONVOLVULACEAE	
Ipomoea alba L.	White morning glory
Ipomoea pes-caprae (L.) R. Brown	Railroad vine
Ipomoea sagittaria Lam.	Glades morning glory
Ipomoea triloba L.	Morning glory
Ipomoea tuba L.	Morning glory
BORAGINACEAE	
Heliotropium angiospermum Murray	Heliotrope
Heliotropium curassavicum L.	Seaside heliotrope
Heliotropium polyphyllum Lehmann	Heliotrope
AVICENNIACEAE	
Avicennia germinans (L.) Stearn	Black mangrove
VERBENACEAE	
Lantana camara L.	Shrub verbena
Lippia nodiflora Michx	Capeweed
LAMIACEAE	
Trichostema suffrutescens Kearney	Blue curl
SOLANACEAE	
Lycium carolinianum Walt.	Christmas berry
Physalis viscosa L.	Ground cherry
Solanum americanum Mill.	Common nightshade
OLEACEAE	
Forestiera segregata (Jacq.) Krug and Urban	Florida privet
SCROPHULARIACEAE	
Bacopa monnieri (L.) Penn.	Monnier's hedge-hyssop

(Continued)

Table 44 (Concluded)

CAPRIFOLIACEAE	
Sambucus simpsonii Rehder	Florida elderberry
CUCURBITACEAE	
Melothria pendula L.	Creeping cucumber
Momordica charantia L.	Wild balsam apple
GOODENIACEAE	
Scaevola plumieri (L.) Vahl	
ASTERACEAE	
Ambrosia artemisiifolia L.	Common ragweed
Baccharis angustifolia Michx	Willow baccharis
Baccharis halimifolia L.	Groundsel-tree
Bidens pilosa L.	Beggar tick
Borrichia frutescens (L.) DC.	Sea ox-eye
Conyza canadensis (L.) Cronquist	White-topped aster
Erechtites hieracifolia (L.) Raf.	Fireweed
Eupatorium capillifolium (Lam.) Small	Dog fennel
Eupatorium serotinum Michx	Late-flowering thoroughwort
Flaveria floridana J. R. Johnston	Florida flavera
Gnaphalium obtusifolium L.	Rabbit tobacco
Heterotheca subaxillaris (Lam.) Britt and Rusby	Camphor Weed
Iva frutescens L.	Marsh elder
Iva imbricata Walt.	Seacoast marsh elder
Lactuca graminifolia Michx	Wild lettuce
Pluchea purpurascens (Sw.) DC.	Saltmarsh pluchea
Pyrrhopappus carolinianus (Walt.) DC.	False dandelion
Solidago sempervirens L.	Seaside goldenrod
Senecio glabellus Poir.	Golden ragwort
Sonchus oleraceus L.	Common sow thistle
Wedelia trilobata L.	

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Lewis, Roy R
Colonial bird use and plant succession on dredged material islands in Florida; Vol. II: Patterns of plant succession / by Roy R. Lewis III, Carolyn S. Lewis, Seabird Research, Inc., Culver City, Calif. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.
vi, 169 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-14, v.2)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C., under Contract No. DACW39-76-C-0161 (DMRP Work Unit No. 4F01C)
Literature cited: p. 27-31.
1. Birds. 2. Dredged material. 3. Florida. 4. Habitats. 5. Islands (Landforms). 6. Plants (Botany). 7. Seabirds. 8. Shore birds. 9. Succession. I. Lewis, Carolyn S., joint author. II. Seabird Research, Inc. III. United States. Army. Corps of Engineers. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; D-78-14, v.2.
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